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Vaccination against Contagious Bovine Pleuro-pneumonia with "Culture-Virus."*

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INTRODUCTION

Contagious bovine pleuro-pneumonia was introduced into the Barotse Province of Northern Rhodesia in 1913 by Barotse cattle used in transport work for the Anglo-Portuguese Boundary Commission. These transport oxen came into contact with infected cattle from Angola. An attempt was made to combat this scourge by inoculation of live virus into the tail (Willems' method). Partly owing to various local conditions but chiefly because of the Great War proper control over the activities was not possible and a large number of animals died following upon the "protective" inoculations. Eventually, the cattle owners politely, but in no uncertain way, made it clear that they preferred the disease *au naturel* to the inoculations. The disease was successfully eradicated from the rest of the territory (Brogan, 1917) and confined to the Barotse Province until 1920, when for economic reasons certain controlled cattle movements were allowed out of Barotseland. As a result of the illegal movement of cattle the disease crossed the border and appeared in the Batoka Province. It was eradicated from the latter province, in 1921, by the "slaughter policy." Restocking of the depleted kraals followed. The following year a cordon was instituted. This cordon has so far been successful in confining this disease to Barotseland and pauperising the Marozi natives.

During the last seven years the native cattle owners have definitely changed their attitude towards this disease. Undoubtedly a great deal of this change of attitude was the result of the successful eradication of foot-and-mouth disease from this province during 1933 and 1934, by the Veterinary Department.

In 1936 the necessary financial arrangements were completed for preliminary investigations to be made into methods of controlling this disease. This work was entrusted to the author who chose the site for the station and also erected the necessary buildings.

The scope of the work was limited to problems of a purely practical nature as many, what may be termed more "academic" questions, could not be investigated at this stage.

The Machili Veterinary Experimental Station was located within the infected area bound by the cordon and yet adjacent to the cattle-owning natives. As the work was progressing it was essenttial not only to strengthen the faith of the more enlightened natives but also to have a constant stream of educative propaganda for general consumption by all native cattle-owners.

The author visited the Veterinary Laboratories at Khartoum in 1934 and also studied the literature on the subject of vaccination against pleuropneumonia during his leave in London in 1934. As a result of this preliminary study and also because the "Willems' Method" of vaccination already referred to had not been looked upon favourably by the local Barotse natives, it was decided to investigate the feasibility of using the culture-virus method of vaccination.

The problem was narrowed down to the major question: "Can the culture-virus vaccine be utilised in combating and eradicating pleuropneumonia in Barotseland?"

It was decided to ask the Veterinary Research Laboratory at Kabete, Kenya, to co-operate by providing the culture-virus. The development of quick air transport made this possible and vaccine was received at Machili within three days of its leaving Kabete.

IMMUNITY AGAINST PLEURO-PNEUMONIA

The fact that "salted" animals were and are still considered of greater value than susceptible beasts in any country infected with pleuro-pneumonia would suggest that an animal that

*The work reported in this paper formed part of a thesis submitted for the degree of PH.D. of London University.

successfully passes through an attack of this disease is less likely to contract, or die from reinfection at a subsequent date. This point was considered by the Committee of the Highland and Agricultural Society (1888) enquiring into this disease. In their report they stated that some authorities apparently believed that immunity followed an attack of the disease, but this opinion was not universally held by all the witnesses examined. It was natural at this stage that the possibility that artificial infection might induce a considerable degree of immunity should have been considered. McCall (1888) stated "Inoculation is an undeniable preventative remedy." Willems (1852) popularised the method of inoculating glycerinated virus into the tail. The problem of how to obtain a sufficient amount of clean and reliable virus for these inoculations then came to the forefront. This logically led to attempts to cultivate the virus and Nocard and Roux (1898) and their collaborators studied this problem. The classical experiments in which they succeeded in cultivating the micro-organism, by incubating Martin's broth, inoculated with a few drops of infective pleural exudate, in capsules, within the peritoneal cavity of rabbits, are well known.

These same authors and Dujardin-Beaumetz (1900) showed also that the micro-organism could be cultivated *in vitro* in a medium consisting of Martin's broth and serum.

Walker (1921*a*) recorded that the virulence of the micro-organism diminished as a result of continuous passage in artificial media. He showed that by the 27th passage the virus became attenuated and caused no ill-effects in animals. His results were very interesting. Using calf-passaged virus in 892 head of cattle he had a mortality of 13 per cent., whilst with the first and second generations of culture-virus in 1,246 head, the mortality rate was 6·4 per cent., and when the 27th to 42nd generations were used the mortality fell to 0·003 per cent. in 4,899 head of cattle. Walker (1921*b*) then developed the culture-virus technique for protective inoculation. His method was to inoculate the vaccine into the tail. Those animals which showed no reaction were then tested in the shoulder, and if this failed to cause a reaction, a third injection was given, again in the shoulder. It must be emphasised that until Bennett (1932) showed that immunity could be produced against this disease without the production of a visible or palpable reaction, it was believed that it was necessary to continue to inoculate an animal until a reaction was produced before such immunity would result. The latter author further advocated a single inoculation method for the nomadic Sudan herds. Turner (1936), working in Australia, also succeeded in cultivating the virus in a modified Martin's broth.

Walker (1922) stated that the "virulence is constant" between the 25th and 42nd generation of culture and that after this no reactions are evoked, so that the "virus must be reactivated by animal inoculations." Knowles (1927) stated that he could find no correlation between virulence and the immunising property of a strain of virus of this disease. Bennett (1932) observed that the virulence, or lethal property, did not disappear suddenly on cultivating the virus. Bennett's work suggested also that immunity was more likely to follow inoculation with young than with the older generations of cultures.

Henderson (1932) reported: "It is difficult to reconcile these severe reactions with the satisfactory results experienced in other provinces unless the susceptibility possessed by cattle is dependent to some extent on local conditions." It was found in Nigeria, by Henderson (1935), that their local virus was not safe until the 117th generation. On the other hand, Bennett (1932) found his virus safe after the 17th generation. Walker (1932) as stated above, working in Kenya, reported that his culture-virus was safe after the 25th passage. Comparative work done in the Gold Coast by Stewart (1935) however, elicited the fact that in local cattle the 2nd generation of the Sudan culture-virus was safe. Thus it would appear that there are two chief factors to be considered in deciding what generation of culture is safe for use in a given locality. These factors are the strain of virus under consideration and the local breed of cattle. However, with reference to the latter factor, Mr. J. L. Stewart, the Director of Veterinary Services of the Gold Coast, in a private communication to Dr. P. L. Le Roux, stated that he found evidence to suggest that it is not so much the breed of cattle *per se* as the local environment which affects the reactions to a given strain and generation of culture-virus. A study of the work of Curson and Thornton (1936), on the breeds of indigenous African cattle, has failed to reveal any correlation between the different breeds and their reported reactions to culture-virus. This is not so surprising in view of the observation of Stewart just quoted. Further, it has been found on the Gold Coast by Stewart (1935) that the 67th generation of the Sudan virus did not produce an immunity. Thus the fact demonstrated first by Bennett (1932), that the older generations took longer to produce an immunity, was confirmed; moreover, very old generations may even lose completely their ability to immunise an animal.

It is evident from the reported work of various investigators that the first questions which had to be answered in Barotseland were:

(*a*) What generations of the Kenya culture-virus were safe?
(*b*) At what generation did the virus cease to produce an immunity?
(*c*) Would the age of the animals in any way influence the results?

The following experiments were therefore carried out:—

EXPERIMENT I.

It was possible to test the Kenya culture-virus in two local types of cattle, the Barotse and Mashukulumbwe breeds. Three cultures were employed, these at the commencement of the experiments were of the 11th, 26th and 39th generations. Generally the dose of culture-virus given was 1 c.c. The temperatures of animals were recorded each morning.

Experiment No. I.

TABLE I

Mashukulumbwe Cattle.

No.	Description.	Passages and Culture.	Dates.	Gland Reactions.	Temperature Reactions.
2	Bull	11, 13, 14 of A.B.	21–11–36	O	O
14	Yearling	,,	15–12–36	O	+
26	Cow	,,	9–1–37	O	O
45	Cow	,,	,,	O	O
19	Calf	,,	,,	O	+
8	Calf	,,	,,	O	+
34	Calf	26, 28, 29 of 981	9–1–37	O	O
12	Calf	,,	,,	O	+
6	Bull	,,	,,	O	O
21	Ox	,,	,,	O	O
28	Cow	,,	,,	O	+
36	Cow	,,	,,	O	+
13	Calf	39, 41, 42 of 604	9–1–37	O	+
10	Calf	,,	,,	O	+
44	Ox	,,	,,	O	+
47	Ox	,,	,,	O	O
39	Cow	,,	,,	O	O
46	Cow	,,	,,	O	O
3	Bull	13,14,17 of A.B.	15–12–36	O	O
40	Cow	,,	9–1–37	O	+
20	Calf	,,	9–2–37	O	O
7	Calf	,,	,,	O	O
53	Cow	28, 29, 32 of 981	9–2–37	O	O
28	Cow	,,	,,	O	O
9	Calf	,,	,,	O	O
30	Calf	,,	,,	O	O
32	Cow	41, 42, 45 of 604	9–2–37	O	O
302	Cow	,,	,,	O	O
23	Calf	,,	,,	O	+
15	Calf	,,	,,	O	+

All the inoculated animals survived and remained in perfect health. None lost their appetite. As will be seen in Table I. of the Mashukulumbwe cattle 12 of the 30 showed a slight rise of temperature, usually between the 8th and 15th day after the first inoculation. On the other hand 24 out of the 30 Barotse cattle had a similar rise of temperature.

Twelve of the 30 Barotse cattle showed enlargements of the coccygeal or prescapular lymph glands, according to whether the tail or shoulder was the site of inoculation. These glands began to enlarge from the 16th day after inoculation and in a few cases became as large as a duck's egg but were usually less. The swollen glands were mobile, cool on palpation and appeared to be painless. The glandular swellings, in some cases, persisted continuously for as long as two months, whilst in others, the swellings fluctuated daily; on some days no perceptible swellings could be detected on palpation.

None of the Mashukulumbwe cattle showed glandular swellings.

The age of the animal inoculated would appear to have been a definite but minor factor in controlling the reactions which followed the inoculation with cultures. Thus nine of the twelve Mashukulumbwe cattle which gave a thermal reaction were less than three years old. Similarly nine of the twelve Barotse cattle with glandular enlargements were under two years old.

No differences were observed in the reactions of the cattle inoculated with the three series of cultures used in these experiments. The youngest generation used—the 11th passage—was as innocuous as the other two, which had been passaged *in vitro* for many more generations.

At first, as advocated by the Kenya Veterinary Authorities for routine field inoculations, the first inoculation was made in the tip of the tail and subsequent inoculations were made into the shoulder. However, as the vaccine was well tolerated by both herds of cattle when inoculated subcutaneously later anywhere in the body, all inoculations of culture-virus were made subcutaneously into the shoulder, as this site is more convenient in every way.

Inoculation of Calves with Culture-Virus

Experiment II.

As each batch of vaccine was received, calves born since the previous inoculation were immediately injected.

In Table II the details and results of the inoculation are recorded.

It was thus shown that calves, even if only five hours old, tolerated the vaccine well when inoculated either into the tail or the shoulder.

Table II

Young Calves.

Origin and Number.	Age at First Inoculation (Days).	Reactions.	
		Temperature.	Gland.
M.124 ...	45	+	+
M.125 ...	43	Died	Coccidiosis
M.126 ...	30	+	O
M.256 ...	5 hours	O	O
S.123 ...	63	+	+
S.257 ...	37	O	O
M.120 ...	5	O	+
S.121 ...	6	+	+
S.122 ...	14	O	O
S.118 ...	22	+	O
S.116 ...	32	+	O
S.117 ...	22	+	O
S.119 ...	14	+	O

M.—Mashukulumbwe.
S.—Barotse.

Experiment III.

The next point to be decided was whether it was necessary to give a course of three inoculations to immunise local herds of cattle. If so, how soon after inoculation did immunity become established? With these questions in view a number of animals were inoculated and the results are recorded in Table III.

Table III.

Mashukulumbwe Stock.

No.	Description.	Passages and Culture.	Dates.	Gland Reactions.	Temperature Reactions.
25	Calf	14, 17, 18 of A.B.	9–1–37	O	O
49	Cow	,,	9–2–37	O	O
54	Cow	,,	3–3–37	O	+
27	Cow	29, 32, 34 of 981	3–3–37	O	O
90	Bull	,,	,,	O	O
91	Calf	,,	,,	O	+
88	Bull	42, 45, 47 of 604	3–3–37	O	+
216	Cow	,,	,,	O	+
89	Calf	,,	Died of Sweating Sickness, 16–1–37		
31	Cow	17 and 18 of A.B.	9–2–37	O	O
30	Yearling	,,	3–3–37	O	+
94	Calf	,,	,,	O	+
100	Calf	32 and 34 of 981	3–3–37	O	+
102	Cow	,,	,,	O	O
103	Yearling	,,	,,	O	+
50	Cow	45 and 47 of 604	3–3–37	O	+
106	Cow	,,	,,	O	O
114	Calf	,,	,,	O	O
18	Calf	34 of 981	3–3–37	O	O
93	Calf	,,	,,	O	+
96	Calf	,,	,,	O	+
24	Calf	47 of 604	3–3–37	O	O
92	Calf	,,	,,	O	+
99	Calf	,,	,,	O	+

Experiment IV.

The next experiment was planned to provide answers to the following questions: Is it safe to work oxen undergoing vaccination with the live vaccine? Does working in heavy rains bring on any ill-effects? Oxen were given a course of three injections and were worked continuously during the period of injections. The work consisted in dragging very heavy logs about for six to ten hours a day, whether it was fine or raining. This experiment was carried out in the middle of the rainy season. All the oxen survived and were not absent a day from work (see Table IV).

Table IV

Adult Working Oxen—All Mazabuka Stock, Mashukulumbwe-European Cross.

No.	Passages.	Dates.	Reactions.
4	T42 of 604	9th January	Nil
5	S32 of 981	9th February	,,
11	S18 of A.B.	3rd March	,,
16	,,	,,	,,
40	,,	,,	,,
43	,,	,,	,,
64	,,	,,	,,
67	,,	,,	,,
111	,,	,,	,,
162	,,	,,	,,
166	,,	,,	,,

T = tail.
S = shoulder.

Experiment V.

Due to the divergence shown between the Mashukulumbwe and Barotse cattle (which were from the Sesheke Boma herd) in their reactions to the vaccine, some old native cows with calves from the Sesheke and Senanga districts of Barotseland were obtained through traders. The results of the inoculation of the vaccine into these are given in Table V.

Table V.

Indigenous Native Stock from Senanga-Sesheke Border.

No.	Description.	Route.	Amount of Vaccine.	No. of Doses.	Dates of Culture.	Reactions.	
						Temperature.	Gland.
128	Cow	Sub/C.	1 c.c.	3	26–5–37	O	O
129	Calf	Sub/C.	1 c.c.	3	9–6–37	+	O
130	Cow	Sub/C.	1 c.c.	3	and	O	O
131	Calf	Sub/C.	1 c.c.	3	7–7–37	O	O
132	Cow	Sub/C.	1 c.c.	3	,,	O	O
133	Calf	Sub/C.	1 c.c.	3	,,	O	O
134	Cow	Sub/C.	1 c.c.	3	,,	O	O
135	Calf	Sub/C.	1 c.c.	3	,,	+	O

Sub/C. = Subcutaneously.

One of the native chiefs made a generous and spontaneous offer to lend cattle for experimentation. The offer was accepted and 34 young animals from 15 months to two years old were received. All these animals were given a course of three injections each of 1 c.c. One of the animals had an intermittent cough reminiscent of the pleuro-pneumonia cough, but as the animal showed no elevation of temperature or other signs of illness, other than the cough, it received the same treatment as the other animals.

Testing for Immunity

Two series of tests for immunity were made. In one series, animals to be tested were herded and kraaled continuously with a herd of about 200 cattle affected with pleuro-pneumonia. This herd was one of the "sick herds" belonging to the Zambesi Sawmills and freshly affected oxen were being drafted into the herd daily.

In the other series, the test consisted of a subcutaneous inoculation of fresh virus into the shoulder.

Immunity Tests by the Inoculation of Virus

In all experiments the technique for testing the presence or absence of immunity by the inoculation of virus was identical. Whenever possible the infective serum was collected from the thoracic cavity of a beast dead of or affected with pleuro-pneumonia contracted under natural conditions. Failing this, the infective serum was obtained from the muscular lesion of an animal dead or killed *in extremis* as the result of a previous subcutaneous inoculation of active virus.

The virus material was collected by aspirating the serum from a cut surface with a sterile syringe and emptying this into a bottle containing sterile preservative, which consisted of one part of glycerine and two parts of normal saline.

Equal quantities of virus material and preservative were mixed and then stored over the freezing unit of a paraffin-burning Electrolux domestic refrigerator. There was invariably ice caked round the freezing unit, hence it is assumed that the temperature was always at, or below, the freezing point of water.

The quantities of the virus material given in the tables refer to this mixture of virus and preservative. All possible precautions against bacterial contamination were taken in collecting, storing and injecting the virus.

In describing the results obtained by this method of testing for immunity the following descriptions and abbreviations are used throughout this work:—

Size of Swelling.—The size of a swelling is represented by a number. A standardised and easy method of description was necessary because of the frequent change of staff necessitated by illness, leave, etc. The arbitrary standards used were as under:—

Size 1	Pullet's egg
„ 2	Large fowl's egg
„ 3	Duck's egg
„ 4	Goose's egg
„ 5	Orange
„ 6	New-born child's head
„ 7	Six-months-old child's head
„ 8	Normal adult's head
„ 9	Football
„ 10	Anything larger than 9

Nature of Swellings.—Very rarely could any heat be detected on palpation of the swellings. In a few cases some heat was noted during the first day or two after the swellings had commenced. The early swellings, that is sizes one to five, were usually mobile, subcutaneous, well-demarcated, plaque-like and hard. The larger swellings were diffuse and became one solid mass attached to the skeleton. In those few animals which lived for more than a day or so, with a swelling designated size 10, there was invariably evidence of the gravitation of the inflammatory oedematous fluid towards the dewlap and legs.

Progress and Termination of Swellings.—In a few cases it was thought possible that a vaccinated animal might have survived the test dose, if secondary complications had not supervened; that is, the virus had probably been overcome, but the tension and mechanical obstruction due to walking movements caused skin necrosis to set in. This was invariably complicated by myiasis and gangrene, necessitating the slaughter of the affected animal.

Where necrosis did not set in, the resolution of the swelling was usually complete in a week to a month. First, the actual site of the needle puncture was retracted, then the swelling became much tougher so that no impressions were left after applying pressure with a finger. This was a definite sign that the inflammatory oedema was becoming organised. The skin of the affected area became dry and scurfy and peeled off; the swelling retrogressed and for many months after, it was possible, on palpation, to detect a very hard node at the site of inoculation consisting presumably of a mass of cicatricial tissue.

In reporting the results following the test dose of virus three terms have been used which require some explanation. When an animal had completely recovered and survived the inoculation with controlled test virus, unless the swelling was very extensive it was described as "immune." Those animals which died or otherwise behaved very similarly to the susceptible control were reported as "not immune." There was, however, a third type of reaction in which the animal being tested resisted the effects of the virus for a long period. In some, destruction was necessitated because of concomitant infections such as myiasis and gangrene, others had to be destroyed owing to mechanical obstruction due to the size of the swelling and a few ultimately recovered. These animals were described as "resistant." In some cases where there was no reaction whatsoever after injecting the virus, even though the susceptible control had succumbed, a second injection of virus was made. In every case where the animal had withstood the first test dose of virus, the second dose confirmed the existence of a strong immunity, as no reaction was noted following upon the retest.

Experiment VI.

It will be seen from Table VI (*page* 37) that, using Mashukulumbwe cattle, 13 were successfully immunised to withstand virus inoculation, two manifested some resistance to the virus and six succumbed.

Since the number of cattle used is small the results cannot have any real statistical value but it is worthy of note that the three cultures used in vaccination did each successfully immunise *some* of the Mashukulumbwe cattle. There is no evidence from this experiment that the oldest generation was in any way less effective in producing immunity than the two younger strains. In fact, although the number is small the cattle inoculated with the oldest strain all resisted the test virus.

There was no evidence to show that those cattle which had reacted to vaccination were in any way better able to resist the virus inoculation than the animals which had failed to react. Similarly, the age of the animal did not appear to affect, favourably or otherwise, the chances of successful immunisation with culture-virus.

Experiment VII.

Table VII (*page* 37) shows the results of testing Barotse cattle and these must be considered along with the results of the previous experiment.

TABLE VI.
Mashukulumbwe Stock.

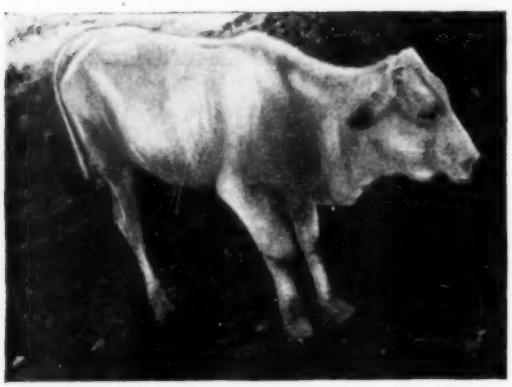
No.	Description.	Vaccination History.				History of Control.	Reactions to Virus.	Conclusions.
		Culture.	Reaction.	First Dose (Days).	Last Dose (Days).			
						Days.	Days.	
27	Cow	981	O	60	1	D23	10TK13	Not immune
15	Calf	604	+	85	29	,,	T	Immune
53	Cow	981	O	85	29	,,	9T	,,
48	Cow	A.B.	+	85	29	,,	10TD30	Not immune
21	Ox	981	O	109	60	,,	10TD30	,,
47	Ox	604	O	109	60	,,	3	Immune
26	Cow	A.B.	O	109	60	,,	1	,,
2	Bull	A.B.	O	112	63	D20	9TK19	Not immune
34	Yearling	981	O	112	63	,,	10TD36	Resistant
46	Cow	604	O	112	63	,,	6	Immune
7	Calf	A.B.	O	112	63	,,	10TD25	Not immune
28	Cow	981	O	112	63	,,	10TK17	Resistant
32	Cow	604	O	112	63	,,	Nil	Immune
6	Bull	981	O	114	65	D25	10TD24	Not immune
45	Cow	A.B.	O	114	65	,,	Nil	Immune
10	Calf	604	+	114	65	,,	4T	,,
19	Calf	A.B.	+	154	105	K20	2	,,
8	Calf	A.B.	+	154	105	,,	10TK23	Not immune
12	Calf	981	+	154	105	,,	1	Immune
13	Calf	604	+	154	105	,,	Nil	,,
30	Calf	981	O	154	105	,,	2	,,
302	Cow	604	O	154	105	,,	1	,,

D23, etc.—Died 23 days after inoculation with virus.
K20, etc.—Killed *in extremis* 20 days after inoculation with virus.
Nos. 1 to 10.—In *Reaction to virus* refer to size of swelling as per page 36.
T, in *Reaction to virus* means had a rise of temperature.

TABLE VII.
Barotse Cattle.

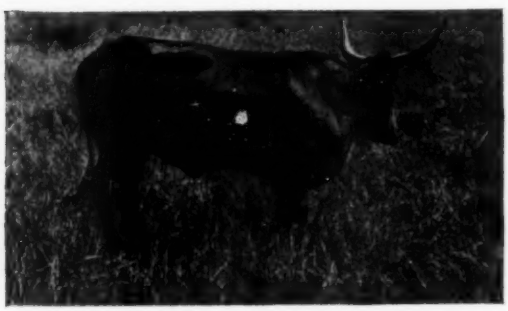
No.	Description.	Vaccination History.				History of Control.	Reactions to Virus.	Conclusions.
		Culture.	Reaction.	First Dose (Days).	Last Dose (Days).			
						Days.	Days.	
57	Yearling	981	+	85	29	D23	1	Immune
66	Cow	A.B.	+	85	29	,,	7	,,
61	Yearling	604	+	85	29	,,	1	,,
55	Yearling	981	+	109	60	,,	Nil	,,
59	Yearling	604	+	109	60	,,	3	,,
81	Cow	A.B.	O	109	60	,,	4	,,
56	Heifer	A.B.	+	112	63	D20	9	,,
82	Bull	981	+	112	63	,,	Nil	,,
60	Yearling	A.B.	O	112	63	,,	Nil	,,
63	Heifer	604	+	112	63	,,	Nil	,,
83	Cow	604	O	112	63	,,	9	,,
68	Cow	981	+	112	63	,,	5T	,,
65	Ox	604	+	114	65	D25	9T	,,
71	Ox	A.B.	+	114	65	,,	9	,,
72	Calf	981	+	114	65	,,	Nil	,,
80	Cow	A.B.	+	154	105	K20	6	,,
85	Cow	A.B.	+	154	105	,,	1	,,
84	Cow	604	+	154	105	,,	Nil	,,
69	Ox	604	+	154	105	,,	Nil	,,
79	Cow	981	+	154	105	,,	4	,,
73	Cow	981	+	154	115	,,	Nil	,,
74	Cow	A.B.	O	154	115	,,	10TK34	Resistant
75	Cow	604	+	154	115	,,	2	Immune
77	Cow	981	O	154	115	,,	Nil	,,

D23, etc.—Died 23 days after inoculation with virus.
K20, etc.—Killed *in extremis* 20 days after inoculation with virus.
Nos. 1 to 10.—In *Reaction to virus* refer to size of swelling as per page 36.
T.—In *Reaction to virus* means had a rise of temperature.



Susceptible calf showing gravitation of virus-oedema down the foreleg.

Calf No. 12, showing almost complete resolution of the swelling. A node of cicatricial tissue only remains.

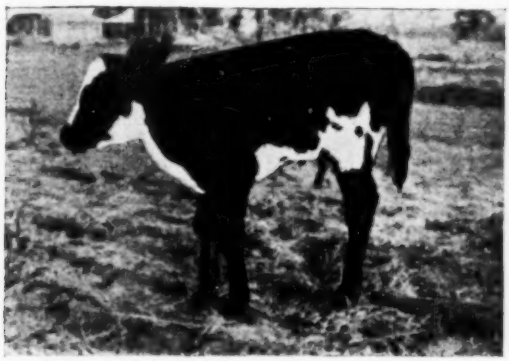


Cow No. 74, Sesheke "resistant" animal. Note inflammatory oedema affecting all the front quarter.

Calf No. 24. Early spread of virus following tail inoculation by the "old method" (Willems).

Calf No. 24. Later, the same animal.

Cow No. 74. "Resistant" animal which put up a long but unavailing fight. Note the immense reaction.



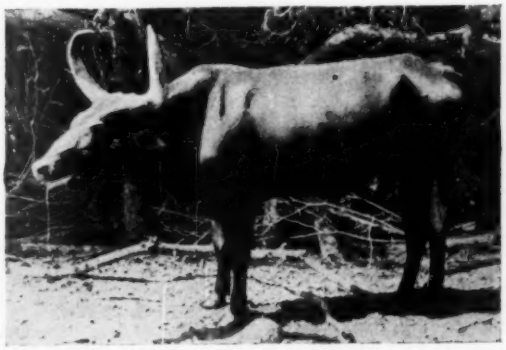
Calf No. 127, born whilst mother was reacting to virus. Note arthritic enlargements probably due to the virus of pleuro-pneumonia.

Ox No. S79, showing reaction to virus, size 7. Animal recovered.

Natural case of pleuro-pneumonia. Note abdominal breathing, engorged facial veins, intercostal muscles tense which with turned elbows are attempting to open the chest barrel. The muscles are in what can be succinctly termed "inspiratory tension."

Cow No. 37, susceptible cow. Showing extensive swelling. (M.K.)

Cow No. S66, showing the process of resolution of the swelling. Point of inoculation in process of retracting. This cow proved immune.



Natural case of pleuro-pneumonia. Note dilated nostrils, stretched neck, froth from mouth, distressed look and elbows turned outwards to extend chest barrel.

It will be noted that all the animals but one withstood the test dose of virus. It would also appear from these results that an animal can be immunised successfully without having shown a local or thermal reaction to the immunising process. Again, it will be noted that age did not appear to interfere with the immunising process, as all animals, irrespective of age, withstood the test dose of virus, with the excepton of one cow, No. 74.

Exposure to Contact Infection

Experiment VIII.—In the month of February, 1937, pleuro-pneumonia broke out in the 1,700 oxen owned by the Zambesi Sawmills. Advantage was taken of this outbreak to expose previously vaccinated animals to "contact" infection. The test was very severe and probably the concentration of infectious material was very much greater than in an ordinary outbreak of the disease, such as might occur in a native herd of cattle. The infected herd consisted of 200 oxen, all sick or dying of pleuro-pneumonia. To this herd, fresh cases were being added as they occurred during the whole period of the experiment.

After 136 days' exposure to contact infection and owing to the absence of fresh cases of the disease, the experiment was terminated.

Heifer No. 86 (see Table VIII) showed a slight elevation of temperature and the herd boy reported a "cough" which he emphasised was *not* a pleuro-pneumonia cough. Subsequently when the animal was chased in our presence no cough could be evoked. The animal was then slaughtered but no evidence of any lung infection was found on *post-mortem* examination. The author was satisfied that this animal was not affected with pleuro-pneumonia.

Four animals which had apparently contracted the disease in a mild form and recovered rapidly were slaughtered. The *post-mortem* examination in three cases (Nos. 14, 36 and 91) revealed only a slight adhesion to the chest wall of the anterior edge of the left lung. No other lesions were found. The other animal, No. 44, had extensive adhesions of the left lung together with a large mass the size of an orange. This mass was composed of a putrefying sequestrum.

One old Mashukulumbwe cow, No. 31, succumbed to pleuropneumonia after a protracted illness. The twelve animals which had successfully resisted all contact infection were then given a test dose of 1 c.c. of virus mixture and some three weeks after this they were given 2 c.c. of fresh infective serum (see Table IX).

Table VIII.

Origin and No.	Description.	Vaccination History. Reaction.	First Dose (Days).	Last Dose. (Days).	Course.	Observations.	Conclusions.
M. 14	Yearling	X	115	66	3	C30T6	Survived
M. 36	Cow	X	115	66	3	C25T10	"
M. 44	Ox	X	116	67	3	C66T11	"
M. 20	Calf	O	116	67	3	E135	Immune
M. 9	Calf	O	116	67	3	C21TK31	P.M.E., P.P.*
M. 23	Calf	X	116	67	3	E135	Immune
M. 25	Calf	O	83	30	3	E63	"
M. 91	Calf	O	83	30	3	C32T6	Survived
M. 216	Cow	O	83	30	3	E63	Immune
M. 31	Cow	O	49	30	2	C37TD85	Died, P.P.*
M. 100	Calf	X	49	30	2	E33	Immune
M. 50	Cow	X	49	30	2	E63	"
S. 62	Yearling	X	115	66	3	E136	"
S. 76	Ox	X	115	66	3	E136	"
S. 87	Cow	X	115	66	3	E136	"
S. 119	Calf	X	88	48	3	E136	"
S. 00	Yearling	X	116	67	3	E135	"
S. 70	Calf	X	116	67	3	E135	"
S. 86	Yearling	X	116	67	3	E116K	P.M.E.,P.P.O
M. 97	Cow	Susceptible Control, D., P.P. lesions at P.M.E.					

M.—Mashukulumbwe.
S.—Barotse.
C.—Contracted clinical pleuro-pneumonia.
C30.—Contracted disease after 30 days' exposure.
E136.—Exposed to infection for 136 days.
T6.—Showed elevation of temperature lasting six days.
D.—Died.
K.—Killed.
*P.P. or O.—Lesions of pleuro-pneumonia present or absent.
P.M.E.—*Post-mortem* Examination.

EXPERIMENT IX.

TABLE IX.

Origin and No.	Description.	No. of Doses of Vaccine.	First Test Dose of Virus.	Result.	Seond Test Dose of Virus.	Result.
			c.c.		c.c. of Fresh Virus.	
M. 20	Yearling	3	1	Nil	2	Nil
M. 23	Yearling	3	1	X1	2	"
M. 25	Calf	3	1	X4	2	"
M. 50	Cow	2	1	X3	2	"
M. 100	Calf	2	1	Nil	2	"
M. 216	Cow	3	1	"	2	X1
B. 58	Yearling	3	1	"	2	Nil
B. 62	Yearling	3	1	"	2	X1
B. 70	Calf	3	1	"	2	Nil
B. 76	Ox	3	1	X1	2	"
B. 87	Cow	3	1	X3	2	X1
B. 119	Calf	3	1	X2	2	X1
177	Yearling Control		1	D22T10	—	—

D21.—Died 21 days after inoculation with virus.
T.—Temperature reaction.
X3.—Local swelling, Size 3, no temperature reaction.
X1.—Local swelling, Size 1, no temperature reaction.
M.—Mashukulumbwe.
B.—Barotse.

It is of interest that those animals which resisted severe "contact" infection also withstood a subcutaneous dose of virus. Owing to the almost insurmountable difficulties of artificially producing the disease in the form in which it occurs under natural conditions it is satisfying to know that the subcutaneous test gives an indication of existing immunity.

Another fact that emerges from the results recorded in Tables VIII and IX is that two animals, Nos. 50 and 100, resisted contact infection and later subcutaneous injection of virus after receiving only two doses of vaccine.

In Table X are recorded the results of testing the immunity in four calves born on the station.

TABLE X.
Barotse Calves.

No.	Description.	No. of Doses.	Generations.	Period Since First Dose (Days).	Period Since Last Dose (Days).	Reaction to Virus.	Results.
116	Heifer	3	41, 42 & 45	203	150	Nil	Survived
117	Bull	3	42, 45 & 47	189	124	"	"
118	Heifer	3	29, 32 & 34	189	124	"	"
122	Heifer	1	34th	—	124	T.5	"
177	Yearling Control					D22T10	Died

It will be noticed that calf No. 122 had only received one dose of vaccine. Although this calf reacted to the test dose of virus, the other three which had received three doses of vaccine showed no reaction. In spite of the swelling and elevation of temperature, it has however to be admitted that calf No. 122 did successfully resist fatal infection.

At this stage of the work it was decided to assemble all the results obtained in experiments in which animals had been tested with virus before they had received the full course of three doses of vaccine. These results are recorded in Table XI (*overleaf*).

No immunity was observed in those cases in which the interval between the inoculation of vaccine and the test dose of virus was short, whilst some evidence of immunity (No. 96) was present when the interval was longer even when only one dose of vaccine was administered.

It will be seen that No. 96, after a prolonged "period of rest," resisted the test dose of virus, whilst its companion No. 99 succumbed, as also did Nos. 24 and 18. The last two, however, had not been rested as long as the first. No. 99 received an older culture (47th) than its companion No. 96 (34th).

Table XI.

No. and Origin.	Description.	No. of Doses.	Generations.	Period Since First Dose (Days).	Period Since Last Dose (Days).	Reaction to Virus.	Results.
M. 33	Heifer	2	17 & 18	55	31	KT10	N.I.
M. 103	Yearling	2	32 & 34	55	31	KT10	N.I.
M. 114	Calf	2	45 & 47	55	31	KT10	N.I.
M. 94	Calf†	2	17 & 18	86	64	—2*	Survived
M. 102	Cow†	2	32 & 34	86	64	—3*	"
M. 106	Cow†	2	45 & 47	86	64	—2*	"
M. 18	Calf†	1	34		64	DT4*	N.I.
M. 93	Calf†	1	34		64	—2*	Survived
M. 24	Calf†	1	47		64	DT5*	N.I.
M. 100	Calf	2	32 & 34	112	93	Nil	Survived
M. 50	Cow	2	45 & 47	112	93	"	"
M. 96	Yearling	1	34		126	—6	"
M. 99	Heifer	1	47		126	KT10	N.I.
S. 122	Calf	1	34		124	T5	Survived

N.I.—No Immunity.
†—Tested by inoculation of virus in tail, remainder tested subcutaneously into shoulder.
*.—Exudation of virus at tail site of inoculation.
K.—Killed *in extremis*.
D.—Died.
T.—Temperature reaction.
Numerals.—Size of swelling after virus inoculation.
On every occasion the virus used was "controlled" by injecting a similar dose into a susceptible animal, which control animal invariably succumbed to the virus.

Experiment X.

As has been recorded earlier, one of the native chiefs arranged for 34 yearlings to be vaccinated. Of these, seven were retained for immunity tests, whilst the remaining 27 were returned after vaccination. One of the seven died of heartwater and the remaining six all withstood a test dose of virus (Table XII).

A mixed group of cows and young calves bought from natives of the Senanga-Sesheke border were injected either intravenously or subcutaneously with varying doses of vaccine.

The results of the inoculation of a test dose of virus into these vaccinated animals are recorded in Table XIII (*see opposite page*).

It will be noted that all these animals sur-

Table XII.
Indigenous Native Yearlings from Sesheke. (Barotse type.)

No.	Description.	Vaccination History. Amount	No of Doses.	Period Since. First dose (days)	Third dose (days)	Virus.	Reaction.	Results.
204	Bull	1 c.c. S/C.	3	100	57	1 c.c.	5 T	Immune
203	Heifer	"	3	100	57	ex	5 —	"
207	Heifer	"	3	100	57	158	4 T	"
200	Bull	"	3	100	57		— T	"
171	Calf	Susceptible Control					6 T	Recovered
257		"					10 T	Dead
210	Bull	1 c.c. S.C.	3	79	36	1 c.c.	— —	Immune
199	Bull	"	3	79	36	ex 154	— —	"
158	Calf	Susceptible Control					10 T	Dead

Effects of Increased Doses of Vaccine

Experiment XI.

The next points studied were: "Will an increased dose of culture-virus in any way help to accelerate the production of immunity? Moreover, will the immunity be stronger if the dose of vaccine is increased?

vived the test dose of virus. It is admitted that the old cows were animals which possibly at some time, had been infected with pleuro-pneumonia and had recovered, but the calves, whose history was known because the majority were born after the cows were purchased, were almost certainly "clean."

Although in this experiment there was some

Table XIII.
Indigenous Native Stock *ex* Senanga-Sesheke Border. (Barotse type.)

No.	Description.	Vaccination History.		Period Since		Virus.	Reaction.	Results.
		Amount and Route.	No. of Doses.	First Dose (Days).	Third Dose (Days).			
128	Cow	1 c.c. S/C.	3	104	88	1 c.c. ex 154	— —	Immune
129	Calf	,,	3	104	88	,,	4 T	,,
130	Cow	,,	3	104	88	,,	— —	,,
131	Calf	,,	3	104	88	,,	4 —	,,
158	Calf		Susceptible Control				10 T	Dead
138	Cow	5 c.c. I/V.	3	60	12	1 c.c. ex 177	— —	Immune
139	Calf	,,	3	60	12	,,	— —	,,
145	Cow	,,	3	60	12	,,	— —	,,
141	Cow	5 c.c. S/C.	3	60	12	,,	— —	,,
140	Cow	,,	3	60	12	,,	— —	,,
148	Cow	,,	3	60	12	,,	— —	,,
142	Cow	1 c.c. S/C.	3	60	12	,,	— T	,,
143	Cow	,,	3	60	12	,,	— T	,,
144	Cow	,,	3	60	12	,,	2 T	,,
147	Calf	,,	3	60	12	,,	— —	,,
132	Cow	,,	3	60	12	,,	— T	,,
133	Calf	,,	3	60	12	,,	— T	,,
134	Cow	,,	3	60	12	,,	— T	,,
135	Calf	,,	3	60	12	,,	2 T	,,
146	Cow	1 c.c. I/V.	3	60	12	,,	— —	,,
154	Calf		Susceptible Control				10 T	Dead

doubt as to the state of the experimental animals before vaccination, yet it was shown that all Barotse indigenous stock resisted infection with fully active virus after vaccination. For reasons already stated it is highly improbable that all these animals had already had pleuro-pneumonia and this belief is further strengthened by the fact that two animals (Nos. 129 and 131) showed a local reaction to the test virus. Eight of the cows have since been slaughtered and no lesions, recent or old, of definite pleuro-pneumonia were found in the lungs. Three of these had lung adhesions which may have been due to any of several diseases, amongst them of course pleuro-pneumonia, but no encapsulated lesions were found.

These experiments with indigenous stock from the Sesheke-Senanga border showed that such animals were not adversely affected by the vaccine and further, that they resisted infection with fully active virus after vaccination.

Experiment XII.

Experiments were undertaken to determine whether the increased dose of vaccine could enhance and hasten the formation of a solid immunity. The doses of vaccine selected were 1 c.c., 2 c.c. and 5 c.c. given on one, two or three occasions. The existence of immunity was tested for after various intervals (*see Table XIV overleaf*).

These results may be summarised bearing in mind three factors—the dose of vaccine, the number of injections and finally the period elapsing between vaccination and the development of a complete immunity (*see Table XV overleaf*).

Amount of Vaccine given at each Inoculation.—It will be seen that all animals which received 2 c.c. or 5 c.c. on one, two or three occasions were found to be immune (*see Table XVI, page* 45).

Number of Inoculations.—It is sometimes difficult to dissociate this factor from the next, *i.e.*, the time factor, when comparing the results. The groups receiving one and two doses had to be tested for the presence of immunity before the animals in the other groups, which were to receive three doses, had had time for the full course of vaccination. It is here necessary to take into consideration the severity of the reaction following the test dose of virus, in estimating the effects of the varied number of injections. The results of the experiments arranged according to the classification are recorded in Table XVII.

Table XVII.

No. of Animals.	How often received Vaccine.	Immune.	Not Immune.
8	Once	5	3
8	Twice	7	1
7	Thrice	6	1

TABLE XIV.

Sesheke Boma Cattle.

No.	Description.	Vaccination History.		Period Since		Virus.	Reaction.	Results.
		Amount.	No. of Doses.	First Dose (Days).	Third Dose (Days).			
252	Heifer	5 c.c. S/C.	2	36	15	1 c.c. Ex. 154	2 —	Immune
239	Ox	..	1	36	—	..	2 —	..
158	Calf		Susceptible Control			..	10 T	Dead
227	Cow	5 c.c. S/C.	3	49	14	1 c.c. Ex 167	— —	Immune
250	Cow	..	2	49	30	..	3 —	..
241	Cow	..	1	49	—	..	2 —	..
157	Cow		Susceptible Control				10 T	Dead
249	Ox	2 c.c. S/C.	3	44	7	1 c.c. Ex 158	4 —	Immune
238	Ox	..	2	44	21	..	1 —	..
229	Cow	..	1	44	—	..	3 —	..
171	Calf		Susceptible Control				6 T	Dead
257	Calf						10 T	Recovered
245	Ox	2 c.c. S/C.	3	65	28	1 c.c. Ex 157	— —	Immune
242	Cow	..	2	65	42	..	2 —	..
231	Cow	..	1	65	—	..	— —	..
151	Cow		Susceptible Control				10 T	Dead
235	Cow	1 c.c. S/C.	3	72	36	Controlled 158 above	1 —	Immune
247	Heifer	..	2	72	45	..	1 —	..
225	Bull	..	1	72	—	..	10 T	Dead, not immune
240	Ox	..	3	85	49	Controlled 157 above	10	..
248	Ox	..	2	85	68	..	7 —	Immune
232	Heifer	..	1	85	—	..	10 T	Dead, not immune
254	Heifer	..	3	106	70	Controlled 151 above	5 T	Immune
247	Heifer	..	3	106	70	..	10 T	..
226	Ox	..	2	106	89	..	10 T	Dead, not immune
230	Heifer	..	2	106	89	..	1 —	Immune
234	Yearling	..	1	106	—	..	10 T	Dead, not immune
228	Yearling	..	1	106	—	..	1 —	Immune

TABLE XV.

(Summary of Results in Table XIV.)

No. of Animals.	Dose.	Immune.	Not Immune.	Period since Vaccination.
	c.c.			Weeks.
5	5	5	None	5—7
6	2	6	..	6—9
12	1	7	5	10—13

The most striking results are those in the animals which received only 1 c.c. doses. In these, only one animal out of four was found immune after vaccination with a single dose, whilst three out of four animals from the two groups which had had two and three 1 c.c. doses of vaccine, resisted virulent virus. There was also evidence that in those animals receiving 2 c.c. doses the reactions to the test virus were least severe in the animals which had received three injections.

The Time Factor.—How long does it take for immunity to develop? In the experiments with 2 c.c. and 5 c.c. doses of vaccine, the virus tests administered 36 days and 44 days, respectively, after the first dose of vaccine, proved the existence of a satisfactory immunity. Again, it is in the group of experiments using 1 c.c. of

Table XVI.

Effect of Amount of Vaccine (total Amount and Amount per Dose).

No. of Animals.	Amount per Dose.	Total Amount.	Period Since First Dose.	Reactions.	Results.
	c.c.	c.c.	Weeks.		
2	5	5	5—7	3—, 2—	Both immune
2	5	10	5—7	3—, 2—	,,
1	5	15	5—7	— —	Immune
2	2	2	6—9	3—, —, —	Both immune
2	2	4	6—9	2—, 1—	,,
2	2	6	6—9	4—, — —	,,
4	1	1	10—13	10T, 10T, 10T, 1—	One immune
4	1	2	10—13	1—, 7—, 1—, 10T	3 Immune
4	1	3	10—13	10T, 5T, 5—, 1—	,,

vaccine that there is evidence to show the duration of the pre-immunity period. This period probably varies within limits with the individual idiosyncrasy of the test animal and also with the total amount of vaccine administered. It will be noted that two animals which had only received a total of 1 c.c. of vaccine succumbed to the virus test made 72 and 85 days, respectively, after vaccination. Of the animals which were tested after a similar lapse of time but had received a total of 2 c.c. and 3 c.c. of vaccine given in 1 c.c. doses, three out of four were immune. No evidence of any immunity whatsoever was demonstrated in animals which had received only 1 c.c. until 106 days had elapsed, and then only one out of two animals tested was found immune. Even after the lapse of 106 days, one of the animals which had received two 1 c.c. doses of vaccine succumbed to the virus test. Similarly, one animal which had received three 1 c.c. doses and was tested 85 days after vaccination died from the artificially induced disease.

There is evidence, therefore, to show that the period elapsing between the inoculation of vaccine and the development of immunity is markedly shortened if the total amount of vaccine administered is increased. This period is, however, further shortened if the increased amount of vaccine is given in one dose.

Mashukulumbwe Cattle

Experiment XIII.

As has been reported already, the Mashukulumbwe breed has proved refractory to immunisation. The technique used in the first experiment was three doses of 1 c.c. each. It was decided to find out whether an increased dose and/or the intravenous route of administering the vaccine would give better results. Table XVIII gives the results of this experiment.

Table XVIII.

Mashukulumbwe Cattle.

No.	Description.	Vaccination History.			Period Since		Virus.	Reactions.	Results.
		Amount.	Route.	Doses.	First Dose.	Third Dose.			
		c.c.			Days.	Days.			
165	Cow	1	I V	3	60	12	1 c.c. Ex 177	10 T	Dead
167	Calf	1	,,	3	60	12	,,	10 T	,,
154	Calf		Susceptible Control				,,	10 T	,,
176	Cow	1	I V	3	126	78	1 c.c. Ex 157	9 T	Immune
151	Cow		Susceptible Control				,,	10 T	Dead
170	Cow	1	I V	3	158	109	1 c.c. Ex 151	10 T	,,
291	Cow		Susceptible Control				,,	10 T	,,
183	Cow	5	S C	3	60	12	Ex 177	10 T	,,
17	Bull	5	,,	3	126	78	Ex 157	9 T	Immune
52	Cow	5	,,	3	158	109	Ex 151	9 T	,,
186	Cow	5	I/V	3	126	78	Ex 151	9 T	,,
163	Cow	5	,,	3	60	12	Ex 177	3 —	,,

Unfortunately three of the animals in the experiment died from other causes and this has made it difficult for definite conclusions to be drawn. It is noteworthy, however, that both the animals which had received 5 c.c. of vaccine intravenously were found to be immune. Of the four which received 1 c.c. of vaccine intravenously, only one was immune. Of the three which received 5 c.c. of vaccine subcutaneously, two resisted the infection with virus.

It is not possible to generalise from a consideration of these experiments alone. It is, however, perhaps significant that the two animals which received the increased dose of 5 c.c. *intravenously* were both immune. This, considered with the results already described in the Sesheke cattle (following administration of an increased dose of vaccine), strongly suggests that an increased dose of vaccine is more efficient in promoting an immunity. To what extent the intravenous is superior to the subcutaneous route it is not yet possible to say. It can be stated that the intravenous is as harmless as the subcutaneous route for administering vaccine and that in animals refractory to immunisation it is not unlikely that the intravenous is the better route by which to give the vaccine.

Safety of Increased Dose.—There has been some doubt as to the safety of increasing the routine dose. The new procedure was first carried out on 30 head on this station. Then, by courtesy of the Zambesi Sawmills Company, it was tried out on 200 oxen and then on 1,200 oxen. Finally, it was decided to use this procedure in the field experiments which have already been described.

Experiment XIV.

In Table XIX are given the protocols of three animals which received massive doses of the vaccine with no ill-effects. The virus loses its pathogenicity through cultivation on artificial media, and it would be rather surprising if the increase in the dose of the viable non-pathogenic organism would alone suffice to restore its original pathogenicity. It is possible on the other hand, that some purely physical or mechanical factor might interfere with the defence mechanisms of the inoculated animal and thus turn the scale in favour of the virus. It was with this possibility in mind that the massive doses of vaccine were tested on susceptible animals.

These three animals were subsequently tested with virus and only one proved immune (Table XX, *see opposite page*).

Vaccine made from Masai strain N.K.

This virus had been obtained from an outbreak of the disease in Kenya and was cultivated at Kabete. The suggestion for this trial originated from Mr. R. Daubney, O.B.E., the Director of Veterinary Services, Kenya.

Table XXI (*see opposite page*) gives the details and results of testing 16 animals which had been previously vaccinated with the strain N.K. for immunity.

The cattle used were of the Mashukulumbwe stock which, as has been previously reported, are difficult to immunise. It will be seen that five of the 16 animals successfully recovered from the test injection of fully infective virus. Only No. 277, however, did not react as alarmingly to the active virus as did the other four. One of the controls, No. 318, recovered after a severe reaction. One, however, of the three animals which were being controlled by No. 318 succumbed to the disease, thus showing that the inoculum was fully infective.

It is noteworthy that the only animals which did survive the test dose of fully infective virus were those that had received three doses of vaccine. The three animals in the 1 c.c. group all recovered when tested at varying intervals. In the two groups where 2 c.c. and 5 c.c. of vaccine had been administered thrice, it was the animals which had been rested longest which eventually withstood the virus test.

A comparison of the results given in Table XXI with those in Tables VI, IX and XVIII, indicates that the vaccine from the Masai strain did not produce any better proportion of immune animals when tested in the Mashukulumbwe cattle.

The number of animals tested after receiving the full course of three doses of 1 c.c., 2 c.c., and 5 c.c. is too small to warrant the drawing of general conclusions. Moreover, when it is

Table XIX.

Result of Inoculating Massive Doses of Vaccine.

No.	Description.	Doses.	How Given.	Result.
266	Bull	100 c.c. vaccine	Three sites on side of neck	No reaction
300	Calf, 4 months	30 c.c. vaccine	One site on side of neck	"
307	Calf, 2 months	15 c.c. vaccine	One site on side of neck	"

Table XX.

No.	Description.	Vaccine Dose.	Test Period.	Virus.	Reaction.	Results.
		c.c.	Days.			
266	Bull	100	46	Ex 11	10 T	Died
300	Calf, 4 months	30	46	Ex 11	10 T	Died
307	Calf, 2 months	15	46	Ex 11	O O	Immune
284	Calf	Susceptible Control		Ex 11	10 T	Died

Table XXI.
M shukulumbwe Cattle, using Masai Strain N.K. cultured Virus subcutaneously.

No.	Description.	Vaccine Amount.	History	Period Since First Dose.	Period Since Last Dose.	Virus.	Reaction.	Result.
		c.c.		(Days.)	(Days.)			
278	Heifer	1	3	121	53	Ex 285	10 T	Recovered
318	Yearling		Susceptible Control			Ex 285	10 T	Recovered
277	Cow	1	3	93	35	Ex 266	O O	Immune
272	Ox		Susceptible Control			Ex 266	10 T	Died
275	Cow	1	3	78	20	Ex lungs	10 T	Recovered
156	Yearling		Susceptible Control			Ex lungs	10 T	Died
287	Cow	2	3	121	53	Ex 285	10 T	Recovered
288	Heifer	2	3	93	35	Ex 266	10 T	Died
285	Cow	2	3	78	20	Ex lungs	6 T	,,
280	Yearling	2	2	121	53	Ex 285	8 T	,,
276	Yearling	2	2	93	35	Ex 266	10 T	,,
293	Cow	2	2	78	20	Ex lungs	8 T	,,
271	Ox	2	1	93	—	Ex 266	10 T	,,
274	Ox	2	1	78	—	Ex lungs	10 T	,,
279	Ox	5	3	93	35	Ex 266	10 T	Recovered
283	Ox	5	3	78	20	Ex lungs	10 T	Died
294	Ox	5	2	78	20	Ex lungs	10 T	,,
270	Ox	5	1	93	—	Ex 266	10 T	,,
290	Cow	5	1	78	—	Ex lungs	6 T	,,

remembered that No. 318, one of the uninoculated susceptible controls, survived the test dose of virus, the apparent incongruity of all the animals in the 1 c.c. group recovering, whilst only two out of five in the two other groups survived, is considerably lessened.

(To be continued.)

THE CHEMICAL SOCIETY

Professor Robert Robinson, F.R.S., Waynflete Professor of Chemistry at Oxford University, has accepted nomination to the office of President of the Chemical Society for the period 1939 to 1941, which includes the centenary celebrations of the Society to be held in April, 1941.

The Longstaff Medal for 1939 has been awarded to Professor I. M. Heilbron, D.S.O., F.R.S., for his outstanding contributions to the science of chemistry in the field of natural products, especially vitamin A and related natural pigments, the antirachitic vitamin D and its precursors, and the constituents of the fish liver oils and of natural resins of the triterpene group.

REFRESHER COURSES FOR PANEL PRACTITIONERS

This year the number of panel doctors attending the fortnight refresher courses arranged by the Ministry of Health after consultation with an advisory committee on the medical side, at 16 medical centres in all parts of the country, will be increased to more than 1,500 from the 1938 figure of 1,100. Arrangements for the selection of individual doctors have been made through the Insurance Acts Committee of the British Medical Association as the recognised body representative of panel doctors. Grants are provided to cover the fee for the course, travelling expenses, and subsistence allowance, and the engagement of a locum tenens where necessary. The cost has been defrayed out of National Health Insurance funds. It is hoped to arrange courses at five-yearly intervals for all panel doctors who wish to take advantage of the available facilities. Doctors are not eligible to take these courses until they have been qualified for five years.

* * * * *

The R.S.P.C.A. has made awards to four men who rescued 124 sheep from a blazing lorry in Romney Marsh some months ago. Bronze medals and certificates go to Mr. Robert Blackman and Mr. Benjamin Palmer, and certificates to Mr. Albert Harris and Mr. Charles Wood.

The Veterinary Record

January 14th, 1939.

The Success of the Goat-Virus Method of Active Immunisation Against Rinderpest in India

As has been noted in several papers, few details have been placed on record concerning the above project. This is attributable, we understand, mainly to two factors. Firstly, the researches undertaken at the Muktesar laboratory between the years 1922 and 1929 upon the production of an attenuated strain of the rinderpest virus were unfortunately not placed on adequately published record. Secondly, owing to the exigencies of field veterinary service in India, it has been difficult to collate for publication information upon the steps which have led gradually to the large-scale adoption of active immunisation of the indigenous cattle with the attenuated strain of virus. From the economic standpoint, however, it now seems fairly obvious that the method has provided a satisfactory solution to the largest single problem in cattle disease in India.

In view of the fact that the cattle population of India is about 40 times as numerous as that of Great Britain, and that in a period when the epizoötic phase is severe the numerical losses from rinderpest approximate the total head of cattle in this country, the new method adopted in India would represent probably the largest recent single achievement in veterinary prophylaxis from the purely economic standpoint. It is to be hoped that all facilities will be provided by the Governments of India and Burma for the veterinary departments to proceed systematically with the wholesale control and eradication of rinderpest by the method. The great importance of this disease is such in these countries that problems like that of foot-and-mouth disease, which are of major concern in Western countries, have been on the whole passed over there as of relatively negligible importance. The method in its special applicability to Indian conditions is largely based on ecological considerations. It is not a method that would commend itself for adoption in Western countries, where, in the first place, rinderpest, as has been well shown, can be readily eradicated by veterinary police measures, and, in the second place, the very high susceptibility of the races of cattle compared with that of the indigenous cattle of India would render its adoption very unsafe. In large parts of Africa, also, it has been shown that the local breeds are usually of much higher susceptibility than Indian cattle, and the attenuated goat virus cannot be inoculated without risk of setting up a severe and even fatal reaction. There is some evidence that as the result of long goat-passage the Muktesar laboratory strain has become a particularly safe one for use in the immunisation of cattle; and, in countries like Burma, where, in particular, the local races of buffaloes are highly susceptible, the dose of anti-serum that need be employed in the serum-simultaneous method of inoculation may safely be greatly reduced in size when in this latter method goat-virus is used instead of the ordinary cattle virus.

A precise indication of the value of the goat-virus method of immunisation in Indian conditions is, however, derived from the carefully recorded statistics of the Military Farms Department. At the several Dairies and Breeding Farms history sheets dating back for several years are kept for all animals, comprising besides indigenous cattle, cross-breds containing varying admixtures of imported European blood, some pure-bred imported stock, and buffaloes. In the last *Annual Administration Report of the Army Veterinary Service in India*, for 1937-38, it is mentioned that the method of immunisation now adopted is to inoculate the pure-bred imported stock with goat-virus and, simultaneously, a good anti-serum, in presumably a small, graded dose; for cross-breds and indigenous cattle the goat-virus is inoculated alone, and a supply of the anti-serum is kept available to control any severe reactions that may arise. In the words of the report, "It is pleasant to record for the second year in succession that no outbreak of rinderpest occurred among cattle of the Military Farms Department. . . . There can be no doubt that the present policy of immunisation is responsible for this satisfactory state of affairs. . . . Owing to the prevalence of rinderpest among civilian cattle incessant vigilance is required to prevent outbreaks among cattle of the Military Farms Department, and it is fortunate that the policy of immunisation is proving so successful. . . ." It is gratifying to recall that the first application of the method

in field practice is in reality to be traced to the pioneer trial early in 1928 at the Karnal Farm of the above Department, when it was observed by a worker (Mr. M. B. Menon)* deputed from the Muktesar staff that "controls," of indigenous breed, inoculated with the goat-virus alone developed a very mild, clinically almost inappreciable, reaction, suggesting the possibility that simultaneous inoculation with anti-serum was not necessary in these breeds. This observation inspired the veterinary staff of the Central Provinces soon afterwards to risk the method cautiously upon the cattle of villagers. Gradually thenceforward the costly and unsatisfactory method of serum inoculation, which was in many ways repugnant to the Hindu minds, for passive immunisation, in the scene of outbreaks has become supplanted, and it now appears to have become obsolete as a standard method of control. This is a gratifying development of the work Dr. Edwards carried out at Muktesar. It is of interest to note the considerable lag that occurs between the production of a method in the laboratory and its acceptance as a measure suitable for wide-scale application in the field.

The resulting transformation in policy has produced an almost complete change in the routine work of the veterinary services in India and wholly altered the outlook in that country regarding rinderpest. For, it was mainly the imminence of this scourge that had gravely hampered rational cattle-breeding and produced the widespread grave deterioration in the live-stock of the country. In skilled veterinary hands in the field in India, the disease now becomes a problem that calls, not for temporisation, but for complete solution. Happily, for well over half-a-century, thanks to the stamping-out measures devised by a former generation of veterinarians, rinderpest, which had also been a chief scourge of livestock in Western countries, has ceased in them to be even a potential menace. The contemporary Indian experience, in arriving at a system of control of this disease, on very different lines, provides, nevertheless, an interesting object-lesson to the present generation of veterinarians in the West. It shows that a grave and large-scale problem in disease control which had apparently baffled all attempts to provide a really satisfactory solution may prove, as the result of systematic research, to be unexpectedly and surprisingly easy of solution.

Imp. Inst. Agric. Res., Pusa. India. 1930. Bull. 199.

ABSTRACTS

[**Recent Advances in Tropical Veterinary Science.** A review of papers presented at the International Veterinary Congress, 1938.]

An interesting point was raised by CURASSON at this congress, as to what diseases are peculiar to the tropics; he would restrict tropical problems to virus diseases transmitted by intermediate hosts, diseases due to rickettsia and those due to parasites which are particularly favoured by tropical conditions. One is, however, inclined to accept the view of CARPANO that the essential difference between tropical problems and those of Europe is due to the difference in conditions of animal husbandry. He suggests that the title of this section of the congress should be changed to "Pathology of Waste Land," which may be taken to mean the study of the diseases of animals under ranching conditions. The majority of authors deal with the various diseases of animals in respect of the peculiar problems which occur under tropical conditions.

Tuberculosis.—DE KOCK records that this disease may assume serious importance in cattle under ranching conditions, and that wild game, notably Kudu, may be naturally infected with the bovine strain. CARPANO records the detection of a strain of the organism in bears from Ceylon which appears to be distinct from classical bovine, human or avian types.

Anthrax.—In areas in South Africa where human population is scarce, the ordinary public health methods of control cannot be applied, and the disease has been dealt with by wide-spread immunisation with spore vaccine. In one area, in which 1,600,000 animals have been immunised annually, the incidence of outbreaks has fallen 80 per cent.

Corynebacterium Infections.—CARPANO records observations on an ulcerative dermatitis of cattle which appears to be due to a bacillus identical with that of human diphtheria, and on a disease of camels characterised by dermatitis, caseous lymphadenitis and pyelonephritis, due to an organism apparently identical with *C. ovis*. In this condition therapy with a formolised culture gave very promising results.

Rinderpest.—DAUBNEY reports that the Indian goat virus is not sufficiently attenuated for use in cattle in Kenya, unless the reaction is controlled with anti-rinderpest serum. He claims to have had a limited degree of success in the cultivation of the rinderpest virus in media containing cells from the embryonic or adult tissues of cattle, goats and rabbits, but has had no success in attempting to establish a neurotropic virus.

Horse Sickness.—100,000 horses have now been immunised in South Africa with the mouse

adapted neurotropic virus, and a total mortality of less than 1 per cent. has occurred on exposure to natural infection. As a result of the work of Nieschulz and du Toit it has been concluded that mosquitoes are not the vectors of this disease.

Bluetongue.—A strain of this virus has been isolated from naturally infected cattle in South Africa. Attempts to establish a neurotropic strain have failed.

Swine Fever.—Whilst in South Africa it is considered that African swine fever is identical with European disease, as the African virus is neutralised by European antiserum, in Kenya the two diseases are considered to be distinct, and it is said that the African virus shows plurality of strains, and a pig which has recovered from one strain of the African virus may succumb to another strain. In South Africa it is recorded that virus has been recovered from the blood of a pig ten months after recovery, and in Kenya the blood of apparently healthy wild warthogs has proved infective.

Rift Valley Fever.—Epizootics of this disease of sheep have only been recorded in or near the Rift valley. The last previous outbreak occurred in 1930 but another existed at the time the paper by Daubney was written. How the disease survived over the intervening period of seven years is not understood, but it is suggested isolated cases may occur, an epizootic only resulting under favourable conditions. A neurotropic virus has been established in mice but caused some loss in sheep from encephalitis, and it is suggested serum-simultaneous inoculation may be a more reliable method of immunisation. No cross immunity has been demonstrated between this virus and that of yellow fever or dengue.

Nairobi Sheep Disease.—The virus of this disease can be transmitted by larvae raised from infected female ticks of the species *Rhipicephalus appendiculatus*. The virus has been successfully passaged by brain to brain inoculation in mice.

Malignant Catarrh.—Daubney records that in six out of nine attempts this disease has been transferred to rabbits by subdural inoculation of brain tissue, and after three passages in rabbits reproduced fatal attacks of malignant catarrh in cattle.

Equine Encephalomyelitis.—This disease, due to the "Eastern" type of virus, is reported from Panama by Kelser. The *Aëdes taeniorhynchus* of Panama was proved capable of transmitting the "Western" type of virus, but the local transmitter of the "Eastern" type has not been identified.

Trypanosomiasis.—de Kock draws attention to the success of the trapping measures in the eradication of *Glossina pallidipes* in Zululand. Whilst in 1931, over 325,000 tsetse were taken in 1,091 traps, in 1937 only 718 were caught, in spite of the fact that 8,487 traps were in operation. He also draws attention to the mild form of dourine in South Africa, and to the unsatisfactory results given by the complement fixation test in donkeys and mules. Daubney emphasises the fact that animals "premunised" to trypanosome infections may relapse under adverse conditions and deprecates undue optimism in regard to the value of the immunity conferred by methods of "premunisation." Kelser draws attention to the difficulty of diagnosis in chronic trypanosome infections, such as "Murrina," a disease of horses due to *T. hippicum* [= *T. evansi*], and the value of the complement fixation test in such cases. He also records that a satisfactory antigen for use in the complement fixation test for the diagnosis of Chaga's disease has been prepared from cultures of *T. cruzi* grown on nutrient agar to which dextrose and guinea-pig blood has been added, the solid medium being covered with a fluid portion of peptone broth and dextrose.

Leishmaniasis.—Donatien and Lestoquard emphasise the chronic course which leishmaniasis may take in the dog and the difficulty in diagnosis. They consider the examination of serum, obtained by the scarification of healthy skin, is the most reliable method of detecting infection, and the best site for examination is the tip of the tail.

Piroplasmosis.—Dschunkowsky records the detection of bodies in the red corpuscles of the kidney blood of cattle suffering from cattle plague. He interprets these as protozoan parasites related to the *Babesia* but differing from that species in that schizogony occurs within the red corpuscles. He suggests that for classification purposes a new family, *Luhsidae*, should be created with one genus, Luhsia, and one species, *L. bovis*.

Theileriasis.—In South Africa fatal theilerial infections, simulating East Coast fever, but apparently not due to *Th. parva*, have been encountered, and have been ascribed to *Th. mutans* in combination with certain adverse conditions. In Kenya it has been found that the tick, *Hyalomma impressum* near *planum* may be responsible for the transmission of *Th. parva*, and that infections transmitted by this tick may be mild, the schizogonous phase of development being restricted to a single lymphatic gland. Successful transmission of East Coast fever to a susceptible animal by *Rhipicephalus appendiculatus* from a case of turning sickness is interpreted as evidence strongly in favour of the identity of the parasites of turning sickness and East Coast fever.

Donatien and Lestoquard, as the result of cross-immunity experiments, agree that *Th. dispar* of North Africa is synonymous with *Th. annulata* of the Near East. They emphasize that after passage by inoculation the parasite

loses its power of development in ticks, and record that 18,000 cattle have been inoculated, in Algiers, with a mild strain of the parasite with a mortality of approximately 1 per cent. only.

Rickettsial Infections.—Donatien and Lestoquard draw attention to the rickettsial inclusions in the monocytes of dogs, cattle and sheep. This infection occurs in dogs in North Africa and Southern France and may be fatal to the host.

Equine Degenerative Arthritis.—This condition has been found to be very prevalent in Panama, and is not confined to old horses. Investigations indicated that army horses and mules were being fed a diet with a relatively low calcium and high phosphorus mineral balance. Alfalfa hay was made a constituent of the diet of army animals in 1935, but no judgment as to its value can yet be given. The analogy between the condition in equines and degenerative arthritis in man is striking, and it is hoped that studies in equines will throw light on the disease in man.

U. F. R.

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"Blackhead." Thirteenth Int. Vet. Cong. Papers, 1938. I.—Bardelli, P., and Menzani, C., Section VI, Poultry Diseases, Heft 10, pp. 34-41; II.—Wetzel, R., and Enigk, K. *Ibid.* pp. 42-48.]

I.—Bardelli and Menzani describe the results of detailed researches on the epidemiological, clinical, pathological and histological aspects of blackhead. They do not consider it possible to diagnose the disease on a clinical examination only since, *inter alia*, the dark colour of the head, often considered as indicative of the disease, may be slight or wanting. Diagnosis should be based on the demonstration of the causal organism in the droppings and on the pathological changes which, however, are only characteristic when the disease is at an advanced stage. The authors consider that, histologically, the pathological changes are due to a granulomatous type of inflammation.

II.—Dealing with the same disease, Wetzel and Enigk regard a mould, *Mycotorula albicans*, and not *Histomonas meleagridis*, as the cause of blackhead since the bacterium is of widespread occurrence in the intestine of poultry and gave a fair percentage of positive results in infection experiments. When the resistance of the host is decreased through lack of care, feeding, or by the presence of parasites, the bacterium can become pathogenic. The authors consider blackhead and Moniliasis or Oidiomycosis to be two different forms of one and the same disease.

J. N. O.

Blood Plasma Changes and Variations in the Female Bovine Toxaemias. Thirteenth Int. Vet. Cong. Paper, 1938. Barker, J. R.]

The data upon which this paper is based were obtained from a study of 300 cases of milk fever, acetonaemia, grass tetany, lactation tetany, transit tetany and pregnancy toxaemias in the female bovine. The author attempts to show that there is a definite correlation between the clinical symptoms observed in these diseases and the sexual cycle, which he divides into the following classifications: parturition and puerperium, anoestrus, oestrus, dioestrus and finally pregnancy. He further correlates the clinical symptoms with changes in the blood plasma, *viz.*:—

> "(*a*) where a hypocalcaemia is linked with a hypermagnesaemia the patient reels, becomes paretic and narcosis intervenes;
>
> (*b*) where a hypocalcaemia is linked with a normal magnesium the patient 'paddles' with the hind legs, becomes recumbent, may or may not get up, finally becomes paretic and coma intervenes;
>
> (*c*) where the hypocalcaemia is linked with a hypomagnesaemia the patient shows tetany of the fore end as well as the hind legs, hyperaesthesia and may become recumbent followed by a convulsion."

[As a record of accurate clinical observation the work must be highly commended and upheld as an ideal after which all clinicians should strive. It is when the author enters the realm of scientific speculation that the paper becomes less satisfying and disappointing to research workers on this group of diseases. Perhaps this is due to the absence of the complete data of the biochemical findings since without them it is difficult to judge whether any of the conclusions are significant or not. The published results of other workers are contrary to some of the findings given in this work and this also makes one careful of accepting the author's hypothesis *in toto*. The author apologises for the use of the misleading word "Toxaemia" in the sense used in the title and general description of the diseases but it would have been better if he had cut it out altogether, since the use in such a loose sense of a scientific term with a definite meaning to pathologists, physiologists and bacteriologists is to be strongly deprecated in a scientific article.]

J. S.

* * * * *

Detection of Mastitis by the Brom-thymol-blue Test, Leucocyte Count and the Microscopic Examination of Incubated Samples of Milk. Fay, A. C., Cave, H. W., and Atkeson, F. W. (1938.) *Cornell Vet.* **28.** 1. 40-50.]

This paper is a progress report on work started at the Kansas Experimental Station in

February, 1935, with the objects of evaluating the above methods of diagnosis of mastitis, determining whether they afforded any fore-warning of trouble, and of attempting to control the disease by a plan of practical herd management.

The herd animals were segregated with three principal groups on the basis of routine examination of individual quarter samples—A, animals regarded as free from mastitis; B, those regarded as suspicious because of a leucocyte count of 500,000 or more per c.c.; and C, those regarded as infected due to the presence in the milk of long-chained streptococci, and usually but not necessarily a high leucocyte count. A comparative study of nearly 7,000 tests was made. The brom-thymol-blue test detected only 21·1 per cent. of infected samples and gave false readings in 1·6 per cent. of cases diagnosed as free from mastitis. There is a 92·7 per cent. chance of a positive result being genuine, and a 44·8 per cent. chance that a negative test is false. The test fails, therefore, to detect a sufficiency of positive cases to be used alone.

The arbitrary standard of 500,000 leucocytes per c.c. is considered too high, since counts above this figure were found only in 36·7 per cent. of samples actually containing streptococci. Bacteriologically the need for repeated tests is emphasised. In 14·7 per cent. of samples from involved quarters of class C cows streptococci were not detected.

Leucocyte counts of over 100,000 and streptococci in medium length chains were frequently found to give warning of impending mastitis.

The incidence of the disease in this herd was 13 per cent. among first lactation heifers, 38 per cent. in second lactation cows, and increased with the age class. Experience showed that it was rarely advisable to re-admit an animal to group A once it had been justifiably moved to a lower category.

F. W. W.

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[Bovine Mastitis. III.—A Comparison of the Bacteriological and Physiological Reactions of Normal and Mastitis Milk from Young Cows. Little, R. B. (1938.) *Cornell Vet.* **28.** 1. 23-33.]

The author reviews the various methods—bacteriological and physiological—which have been used in the diagnosis of mastitis by examination of milk samples. He also discusses the selection of samples and their preliminary treatment, and gives some statistics comparing bacteriological examinations of fore- and middle-milk and strippings. He then gives details of the methods employed in his investigations.

This paper contains a review of the daily laboratory examination of the fore-milk from 31 quarters of eight young cows before and after infection with streptococci.

The tests employed were: (1) Colorimetric hydrogen-ion determination; (2) determination of the presence of chlorine; (3) the leucocyte count, and (4) bacteriological examination. 1,010 daily examinations of normal fore-milk were made and most of these fell within the generally accepted normal limits. After the production of experimental streptococcal mastitis, 2,163 daily examinations of the fore-milk were made.

The author's conclusions as to the relative efficiency of the various methods are in favour of bacteriological plating on blood-agar. The opinion is expressed that the next most reliable test is the direct leucocyte count. Hydrogen-ion and chlorine determinations were found to be of less value. It is generally recognised that bacteriological examination is the best, if not the only reliable method of diagnosis in sub-clinical cases.

Although the leucocyte count is regarded as the next most reliable method the wide variations encountered are illustrated by the figures given. In the normal milk of the heifers under examination 95 per cent. of samples gave counts of 300,000 per c.c. or under. After the onset of sub-clinical mastitis 94 per cent. of samples showed counts of 300,000 to 10,000,000 cells per c.c. It is also stated that in older cows which so far as can be determined are normal, counts between 500,000 and 1,000,000 per c.c. have been recorded. If the method is to be employed it follows that some standard must be fixed for a given type of animal, but it may well be asked whether the present of 300,000 or even 100,000 leucocytes per c.c. in milk is not pathological.

F. W. W.

POSTPONEMENT OF NEW MILK REGULATIONS IN EIRE

New milk regulations in Eire which were to have come into operation on January 1st have been postponed until April 1st, 1939, under an order made by the Minister for Local Government and Public Health. The regulations are: Milk and Dairies (Special Designations) Regulations, 1938; Milk and Dairies (General Designations) Regulations, 1938; and Milk and Dairies (Sale of Heated Milk) (Restriction), 1938.

Grading of milk intended to be sold for human consumption is provided for under the Special Designations Order. The prescribed grades are "highest grade," "standard milk," and "pasteurised milk."

General Designations Regulations prescribe the general designations which may be used in the sale of milk: they are "milk," "new milk," and "fresh milk."

On and after April 1st, 1939, it will be an offence to use any descriptive words or signs in connection with the sale of milk other than a special designation or a general designation.

REPORT

[Army Veterinary Service in India. *Administration Report*, 1937-1938.]

The report covers all army animals in India and Burma, the average strength of which was: Horses, 31,540; mules, 28,219; camels, 3,781; cattle, 12,758; donkeys, 172—total average strength 76,470, against 76,178 in the previous year. There is a reduction in the number of horses and mules and an increase in the number of cattle.

The establishment of the Army Veterinary Service during the period under review included British cadre officers 35, a decrease of 9; British officers, continuous Indian cadre 28, an increase of 10; Indian commissioned officers 16, an increase of one; veterinary assistant surgeons 24, against 124 in the previous year and some 700 other ranks. The recorded decrease of one hundred in the number of veterinary assistant surgeons employed is remarkable. It may be due to a clerical error.

Military veterinary institutions comprised 67 hospitals, two schools, a record office, a depot and a laboratory. This newly-established laboratory at Lahore which works in close collaboration with the Imperial Veterinary Institute, Muktesar, is reported to be proving itself invaluable and the nucleus of a good library has now been provided. A good start has certainly been made in investigational and experimental work in addition to diagnostic routine.

Disease

The general condition of the animals in the Army is reported to have been good, and although an average of 1,828 horses, 8,247 mules and 780 camels was employed continuously on operations in Waziristan from April to December, the wastage from all causes remained the same as the previous year.

Under "general diseases" *colic* continued to be troublesome in a few units but improvement in stable management is advised where necessary, with good results.

Under "specific diseases" *anthrax* gave cause for anxiety during the Waziristan operations but the outbreak was dealt with promptly and successfully.

Contagious pneumonia in horses is reported to have been treated beneficially with neosalvarsan administered intravenously.

It is gratifying to report that no cases of *glanders* occurred during the year, and also that the cattle of the Military Farms Department were free from *rinderpest*.* An extensive outbreak of *influenza* in camels occurred in Waziristan. Treatment with neosalvarsan was remarkably successful.

Strangles at the several Remount Depôts is a serious problem as it is the cause of considerable mortality. An officer has been placed on special duty in this connection and, in consultation with the Director of the Imperial Veterinary Research Institute, experimental work is being conducted.

With the aid of the mercuric chloride test and treatment with naganol, *surra* in camels is no longer a menace and the report shows in detail how outbreaks can now be dealt with successfully.

Horse Breeding Areas.—In one area particularly, *joint-ill* in foals continues to be a serious problem. It is reported that in one area where it was very prevalent the cross-branding of mares which were known to be carriers has lowered the mortality by about 75 per cent. Sterility in mares occupied the attention of the veterinary officers. A special investigation is being conducted with the aid of a special grant of money from the National Horse Breeding Society of India and should prove to be of great value.

Miscellaneous.—The report includes an interesting section regarding the evacuation of animals by mechanical transport and it is stated that a booklet is to be issued relative to the experiences gained in the recent Waziristan operations, which should prove useful.

G. K. W.

*See leading article, page 48.—Editor.

REVIEW

The Farmer's Guide to Agricultural Research in 1937.

That the lessons of research are not always readily accessible to those who would benefit by learning them is a fact which the R.A.S.E. came to recognise more than a decade ago when the publication under review first saw the light of day. The difficulty is not one of reluctance on the part of the research worker to divulge his results but rather a problem of language and broadcasting.

The *Farmer's Guide* covers such aspects of agriculture as Plant Breeding, Animal Diseases, Machinery, Economics, Dairying, Livestock, Soils and Pests and its value is greatly enhanced by the fact that each section is the product of men with a wide knowledge of their subject and capable of selecting from a mass of material only such as is indicative of recent progress.

This book is naturally of no great interest to the specialist research worker nor will it provide enlightenment to that section of the agricultural community which still clings to traditional superstitions, but for the intelligent farmer, using the word in its widest sense, it provides much food for thought.

N.V.M.A. DIVISIONAL REPORTS

Eastern Counties V.M.A.*

AUTUMN MEETING AT CAMBRIDGE

The Autumn Meeting of the Association was held at the Institute of Animal Pathology, Cambridge, on Friday, October 21st, 1938.

The President, W. H. Dennett, Esq., occupied the Chair and the following members were also present: Messrs. F. Blakemore, T. J. Bosworth, M. Bray, J. Buckingham, B. A. Claxton, T. Dalling, F. L. Gooch, S. E. Hill, T. G. Heatley, E. S. James, H. J. Loveless, J. G. Murray, G. Dunlop-Martin, C. H. McGaughey, C. T. Murphy, J. S. Paterson, S. G. Poles, N. F. Pollock, E. B. Reynolds, K. C. Sellers, H. C. Swann, E. B. Smith, H. P. Standley, Sen., J. F. Thurston, P. R. Turner, P. Welch, W. A. Wood, R. R. Willing, W. H. Wortley, R. W. A. Watchorn and the Hon. Secretary. Messrs. O. S. Broadhurst, R. Ford, F. W. L. Gooch, H. C. Gregory and Dr. W. R. Wooldridge were present as visitors.

At the outset of the meeting, the President mentioned that the Society had lost two of its oldest and most respected members in the passing of Mr. D. S. Jack of King's Lynn and Mr. W. J. Browning of Ipswich. As a token of respect to these gentlemen, the members stood in silence for a few moments.

The minutes of the Summer Meeting, as published in the *Veterinary Record*, were taken as read and signed.

Letters regretting their inability to be present were received from Messrs. F. Castle, J. M. Currie, A. V. Franklin, Sir F. Hobday, H. J. Loveless, H. V. Low, G. T. Matthews, G. Muir, R. J. O'Neill, C. C. Nesling and R. P. Webber.

It was decided that the next meeting should be held in Norwich in February.

Diseases of Poultry

A poultry lecture at the kind invitation of Major Dalling and lectures dealing with the diseases of poultry were then given, followed by a tour of some of the laboratories, where actual diseased birds and various specimens dealing with poultry diseases were demonstrated.

The following gentlemen gave lectures: Professor T. Dalling, Coccidiosis; Mr. J. S. Paterson, Bacillary White Diarrhoea; Mr. F. Blakemore, Infectious Diseases of Poultry; and Mr. C. A. McGaughey, Non-Specific Diseases of Poultry.

At the conclusion of the lectures, the members were entertained to tea by Professor Dalling.

The President proposed a hearty vote of thanks to Professor Dalling and his staff, for hospitality received, and for a most instructive and interesting afternoon. This was carried amidst applause.

After tea the meeting re-assembled to consider a letter received from the N.V.M.A., inviting the Association to nominate members to serve on the Provisional Committee for the Association's Congress to be held in Great Yarmouth, next year. The President welcomed Dr. W. R. Wooldridge, the Hon. Secretary of the N.V.M.A., whom he understood had come down to explain the duties of the Provisional Committee. Dr. Wooldridge said it was his intention since his election as Hon. Secretary to the N.V.M.A., to visit all the Divisions, and as next year the Association's Congress was to be held in Great Yarmouth, he felt it his duty to visit the Eastern Counties Division first. He then went on to explain the duties of the Provisional Committee.

The following gentlemen were elected to serve on the Committee, *viz.*: Messrs. F. Blakemore, B. A. Claxton, J. Bosworth, J. M. Currie, T. Dalling, W. H. Dennett, T. G. Heatley, S. E. Hill, C. T. Murphy, E. B. Reynolds, W. Shipley, H. P. Standley, Sen., and Jun., P. R. Turner, W. A. Wood and W. H. Wortley.

The meeting closed with a vote of thanks to the President for his conduct in the Chair.

H. P. Standley, Jun., *Hon. Secretary.*

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North of England V.M.A.*

MEETING AT NEWCASTLE-UPON-TYNE

A general meeting of the North of England Veterinary Medical Association was held in the Agricultural Department, King's College, Newcastle-upon-Tyne, on Saturday, December 10th, 1938, when there were present: The President (Mr. E. R. Callender), Messrs. J. R. Rider, T. M. Mitchell, G. S. Beattie, J. D. Peele, G. M. G. Oliver, H. Burkitt Allan, G. F. Pickering, A. L. Bartholomew, J. W. Rider, T. Wilkinson, D. Starkey, the Hon. Secretary, Mr. W. Lyle Stewart, with Messrs. G. R. Taylor and S. G. Wilson as visitors.

Apologies for absence were received from Messrs. Hill, Jackson Young, McDowall and Taylor.

The minutes of the last meeting, having been published in the *Veterinary Record*, were taken as read and signed by the President.

Correspondence.—Under correspondence the Secretary read a letter received from the

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*Received for publication December 22nd, 1938.

Royal Sanitary Institute asking if the Division wished to send a delegate to their Congress in Scarborough next July. It was resolved that no action be taken. A letter was also received from Dr. G. B. Brook, who wrote to say that he was unable to attend the meeting and read his paper entitled "Tuberculosis Eradication and Tuberculin Testing in Foreign Countries." The meeting resolved that the Secretary should send a letter to Dr. G. B. Brook sympathising with him in the special circumstances which prevented him from attending the meeting. The Secretary then read the full correspondence between the Division and the "National" referring to the question of fees for the testing of certain herds in the dale districts. The Consultative Committee had suggested that a representative from the North of England Division should be nominated to attend the next meeting of the Consultative Committee at which this question would be discussed. It was resolved that Mr. J. R. Rider be nominated to represent the Division, the Secretary to deputise in the event of Mr. Rider being unable to attend on the day proposed. The President read a letter from Sir Frederick Hobday expressing his regret at being unable to attend the general meeting and at the same time thanking the members for their attendance at his lecture to the Agricultural Students of King's College on December 2nd.

Elections to Membership.—On the proposal of Mr. Wilkinson, seconded by Mr. J. W. Rider, Mr. W. A. Campbell, Boroughbridge, and Mr. T. C. Hall, Knaresborough, were elected to membership of the Association.

ELECTION OF OFFICE-BEARERS

The following officers were elected for 1939:

President.—Mr. H. B. Allan.
Senior Vice-President.—Mr. E. R. Callender.
Junior Vice-President.—Mr. J. D. Peele.
Hon. Secretary and Treasurer.—Mr. W. Lyle Stewart.

There were two vacancies on the Council, and Mr. C. Nicholson and Mr. J. J. McDowall were elected to fill these.

There being no paper, the meeting considered a number of clinical cases submitted by Mr. T. M. Mitchell, Mr. J. R. Rider, Mr. W. A. Doughty, Mr. G. M. G. Oliver and the Hon. Secretary.

Under "Any other business," Mr. H. B. ALLAN made the suggestion that in order to bring the Division into line with the custom obtaining in other professions, the Division might consider the advisability of arranging to hold a dinner. At this dinner the Council might wish to ask a number of official guests and each member could bring private guests. If a dinner such as was proposed proved successful, there was no reason why it should not be made an annual feature of the social activities of the Division. The meeting expressed approval of the principle and the Hon. Secretary suggested circularising all the members in order to obtain their views. Meanwhile, it was resolved to appoint a Sub-Committee with power to act composed of Messrs. Allan, Peele, G. F. Pickering, the President and the Hon. Secretary. Mr. W. A. Doughty suggested that Alnwick might prove a suitable venue for the June general meeting, especially if it were decided to ask Dr. Brook to attend and read his paper then.

There being no other business, the meeting concluded.

W. LYLE STEWART, *Hon. Secretary.*

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Ayrshire V.M.A.

PRESENTATION TO MR. S. J. EDWARDS

A meeting of the Ayrshire Division of the N.V.M.A. was held in the Ayrshire and Galloway Hotel, Ayr, on December 30th, 1938.

The President, Mr. R. M. Smith, Galston, was in the Chair and the following were present: Messrs. Edwards, Gillmor, McGregor, Weir, Gardner, Moodie, Gordon, McKenzie and Brown.

A deputation of farmers, including Colonel Houldsworth, Kirkbride, Maybole, and Mr. A. W. Montgomerie, Lessnessock, Ochiltree, was also present.

The occasion was a presentation to Mr. S. J. Edwards, B.Sc., M.R.C.V.S., of the Hannah Research Institute, as a token of respect and esteem, on his leaving the district to take up a new appointment at Compton, Berks.

Mr. DAVID WEIR, Ayr, made a presentation to Mr. Edwards on behalf of the veterinary practitioners in Ayrshire. This took the form of a solid silver coffee service with a salver on which the signatures of the subscribers were engraved. In his speech Mr. Weir made reference to the friendship and co-operation which had existed between Mr. Edwards and the practitioners during the five years the latter had spent at the Hannah Research Institute, and gave him the good wishes of the practitioners for his success in his new appointment.

Colonel HOULDSWORTH, on behalf of Mr. Edwards' farmer friends, then presented him with a wallet of notes. In his speech he made acknowledgment of the research work which was being done by the veterinary profession in trying to assist the farmers to eradicate especially tuberculosis, mastitis and abortion, and expressed their gratitude in particular to Mr. Edwards for his work during his stay at the Hannah Research Institute.

SOME CONTEMPORARY CONTRIBUTIONS TO OUR KNOWLEDGE OF ANIMAL HUSBANDRY

(*Continued from Vol. 50, page 1750*)

Milk Secretion

In the June and July (1938) issues of the *Journal of the Ministry of Agriculture*, Dr. Crowther contributes a long and useful discussion on "Milk Secretion." We have used this freely in the following article.

If an ox on growth or fattening rations is put on a ration sufficient for maintenance only, liveweight increase stops at once, to be resumed again when a production ration is fed subsequently. In a milking cow treated similarly, cessation of milk secretion does not occur at once. A reduction takes place and the rate of secretion is slower. When full rations are given later, full secretion is not immediately restored. This is due to the fact that in the first case, the response to altered feeding is by the whole body system, whereas in the latter case the effects concern only one organ, the mammary gland.

Factors Influencing Mammary Activity.—Glands are somewhat specialised structures whose functional activities are due to the particular physico-chemical and physiological condition in which they happen to be at a given time. In the mammary gland, the important constituents of the milk are manufactured by chemical processes in the gland itself by withdrawal of basic substances from the blood stream.

Various external factors can raise or lower the volume of milk secreted, but the limits of change either in quantity or quality depend upon the particular physiological processes and the chemical status of the gland cells at any particular time. Fluctuations of these conditions are responsible for fluctuations in the volume or constituents of the milk itself at different stages of an animal's life. All other influences—even the influence of food—are of secondary importance compared with this basic and fundamental functioning within the udder itself.

While the influence of food is in the long run of great importance in dairy herd management, no amount of food—of whatever excellent quality, and however accurately balanced (and despite the most perfect management of the herd)—can convert an intrinsically bad milking cow into a good one. The basic potentialities for milk secretion are inherited from parental ancestry and therefore fundamental levels of secretion are fixed at the time of mating. It is, however, common knowledge that bad management, poor feeding, disease, etc., may each prevent an individual cow from ever yielding the maximum amount of milk of which she is genetically capable.

Relation to the Sex Organs.—The functional activity of the udder is, of course, associated with, and to a large extent dependent upon, the cyclic changes and activities of the sexual organs. These in turn are regulated and stimulated by hormones produced from anterior and posterior pituitary, thyroids, adrenals and possibly other ductless glands.

Importance of Hormonic Control.—Though great advances in knowledge have been made during recent years, regarding the hormone control of sex activity and lactation, a great deal still remains to be elucidated before we can hope to understand the whole process.

So far as the udder itself is concerned, there are at least three hormones of primary importance in the control of its functioning, and possibly several of secondary importance. *Firstly*, there is oestrone, produced in the ovary, which initiates the development of the duct system in the gland; *secondly*, progesterone, also of ovarian origin, which stimulates the growth and development of the acinar secreting cells; *thirdly*, prolactin (or "galactin") from the anterior pituitary, which initiates functioning of the secretory cells and is the activating hormone of the udder at parturition. There is some evidence that the thyroid may play a regulatory part in milk secretion, but it may be that this is only an end result of control by the pituitary through its thyrotropic factor.

Relations to Growth and Maturity.—It should be noted that the anterior pituitary is also responsible for producing growth hormone as well as the gonadotropic hormones. It would appear that these cannot readily be produced and utilised simultaneously. Growth hormone predominates up to puberty, and subsequently the sex-stimulating hormones are produced and growth factors diminish (except probably in the female during pregnancy when they are utilised for foetal growth). It is suggested that a possible adverse influence upon growth of an animal may result from unduly premature sexual activity and breeding, whereby the pituitary production of growth hormone is embarrassed by the need for producing gonadotropic hormone. There is also, however, the possibility that in the female, diversion of growth hormone to supply the needs of the foetus *in utero* may seriously limit the amount available for the dam for the completion of her own growth processes. This might well explain why unduly early gestation in the heifer has a stunting effect upon ultimate body growth and functioning.

The thyroid and pituitary hormones are not only of importance in initiating lactation, but they are needed for its continuance. The diminishing volume of milk produced by a cow towards the end of the lactation is not due to failure of the hormone control, however; it is due to the natural process of exhausted functioning. The secretory cells, built up during pregnancy (or the previous dry period) are not replaced as they become "worn out." If a new pregnancy has begun, and especially if it is well advanced, the failure of secreting cells is more rapid.

Fluctuations in Yield.—It is a familiar phenomenon that milk yield rises for the first six to 10 or 12 weeks after calving, when it reaches a "peak" at which it remains fairly

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Mr. Edwards, in reply, expressed the pleasure he had experienced in being associated with the practitioners in Ayrshire, and thanked them for the presentation which, he said, was a gesture of goodwill he appreciated very highly. He also thanked Colonel Houldsworth for his remarks and the presentation on behalf of the farmers.

The company was thereafter entertained to tea by the Ayrshire Division and a pleasant afternoon was spent.

The meeting terminated with Mr. Montgomerie proposing a vote of thanks to the Chairman, Mr. Smith.

David Brown, *Hon. Secretary.*

steady for a time, and then subsequently it slowly falls. The time taken to reach the "peak" and the duration of maximum yield are partly inherited, partly a reflection of efficiency of management, and partly dependent upon the treatment during the previous dry period. During the phase of rising secretion, the immediate feeding and management have little influence. The influences associated with parturition stimulate the hitherto inactive udder to full activity but a time elapses until the maximum flow is achieved. The impulse to secrete is strong and the cow will draw upon body reserves to make good any deficiences in the intake of nutritive substances. No matter how she is fed she is almost certain to lose some weight during this period. This fact makes it important to ensure that the cow should be got into best possible condition before she calves, so that she may have adequate reserves available to draw upon. It is recommended that during the rising phase of secretion, the rations need not be of the maximum "forcing" type except perhaps where record productions are desired. They may even be a little below actual requirements until the peak is reached, when the full rations according to the actual amount of milk secreted should be fed.

In the post-peak phase, the decline should be regular and gradual. The measure of the rate of decline is a measure of the "persistency" of the cow. It varies greatly between different lactations and between individual cows. It is suggested strongly by some records that a genetic factor or factors may be involved, for families of "stayers" (in which persistency is high), and families of "sprinters" (in which persistency is very low), can be encountered. The occurrence of another pregnancy can influence the rate of decline in yield markedly, but not during the first 20 weeks or so after service. Thereafter, however, pregnancy exerts a dominating influence in the decline and ensures for the cow a recuperative or dry phase, during which reserves can once more be accumulated. This process needs supervision, for many or most cows will continue to secrete some milk right up to calving unless they are dried off. There is clearly no physiological mechanism for the arrest of secretion to ensure a rest between lactations. It is during the peak, and especially during the decline, that under-feeding can adversely influence the amount of milk produced most powerfully but no system of feeding can overcome the natural decline in any cow.

Where lactations are of about equal length the amount of milk per lactation increases to a maximum during the first three, four, or five lactations, whereas the persistency of the peak period tends to decline in duration in succeeding lactations. To measure and compare these results not only must the lactations be of equal length, but the recuperative dry periods must also be equal and the management must be standardised.

The increasing total yields in successive lactations are consequently mainly accounted for by the greater rate of initial secretion (since persistency is becoming less). The longer the dry period, however, the greater the "persistency" in the next lactation, particularly in the earlier lactations. Shortening the dry period before the second lactation will usually lower the yield more markedly than shortening the dry period before a later lactation, since in the earlier period the cow is not mature and some food is diverted to complete body growth, which competes with milk secretion.

Physiological Basis of Secretion.—Much still remains to be discovered regarding the exact biochemical processes involved in the production of milk by the mammary gland. During recent years considerable progress has been made and we now know more of the details of the process than before. Some of the older ideas have been found incorrect.

Most of the organic constituents of milk are actually elaborated in the gland itself by the secreting cells. These are not found elsewhere in Nature. Other constituents, such as minerals and some of the proteins, pass from the blood stream into the milk without much change. Earlier it was believed that the production of milk involved destruction of the secretory cells of the gland; it was thought (on histological evidence at various stages of secretion) that cell granules formed lactose and fat, while cell nuclei produced the proteins. This view is not now tenable though some workers hold that a certain degree of destruction of cells does actually occur; most authorities, however, regard milk as a product of true secretion.

Apart from a short pause immediately after the udder is emptied, milk secretion is a continuous process. Secretion is rapid in the recently emptied udder, and as milk accumulates in the tubules and acini the intra-mammary pressure rises and the rate of secretion becomes slower. Only a small amount of milk normally reaches the milk cisterns in each quarter; the remainder is held up in the gland itself. When milking or sucking occurs, nerve stimuli received by teat and mammary skin cause a reflex tensing of plain muscle of blood vessels and of the gland substance. This produces vascular congestion and the so-called "erection" of the udder which raises intra-mammary pressure still higher; accumulated milk is forced out into the cisterns and the cow "lets down her milk."

During milking, the "fore milk" may contain some of the "strippings" from a previous milking and possess a considerable fat content, but otherwise the milk drawn shows a steady increase in fat content (from about 2·3 per cent. at first, to 3·0 per cent. about the middle of milking, and to as much as 6·5 per cent. or more in strippings). This fact led to the belief that milk secretion occurred in two stages—at first a slow, steady secretion, poor in fat and occurring between milkings; secondly, during actual milking, a rapid secretion of a small volume of milk rich in fat, chiefly brought about by the stimulus of milking. Evidence, thought to be conclusive, was adduced in support on the basis that no udder could hold as much as the cow might yield at a milking. Further evidence seemed to be given by the profound effect on milk secretion shown by good and bad milkers. More and richer milk is obtained by a quick, stronger milker than by a slow, inefficient milker.

Recently, a considerable body of work has been carried out to show that this explanation is untenable. (Readers who wish to consult details are referred to articles by Hammond, published in the *Veterinary Record* in 1936. *Vet. Record.* 16. 17. 519-527 and 528-535.)

It is a well-known fact that the way in which milking is carried out has a great influence upon the quality and quantity of milk produced. The prime requirement of efficient milking is the speed at which the four quarters can be emptied, subject to the avoidance of undue disturbance of the cow. From this aspect, milking machines, properly and efficiently operated, would seem to be ideal since they deal with all four quarters simultaneously. Probably the present major disadvantage of the milking machine is that it is

not so designed that as soon as any one quarter is emptied suction upon that quarter ceases. Machines, to be satisfactory, must also be able to milk the cow out as quickly as, or quicker than, the best hand milker.

Variations in Milk Secretion.—Milk, being a mixture of several different substances, is very subject to variations in composition. The most variable ingredient is fat, but every constituent may readily vary, protein and ash following variations in fat fairly closely. The secretion of fat has been given more attention than the other constituents, chiefly because fat is used as an index of commercial quality to a greater extent than other substances. Fat content has been regarded as being an inherited characteristic, but the profound influences of environment and management must be given due consideration. Variations in amount occur over a wide range in different stages of lactation; from day to day in some individuals, from breed to breed, and from quarter to quarter. No adequate explanation has yet been offered to account for all these variations.

One important association of fat content is with total yield. Almost any factor which causes a lowering of yield results in a rise in the fat content, while the opposite also holds good. Exceptions to this rule are, however, seen when through some serious bodily disturbance or attack of disease, a sudden drop in milk yield occurs; in such instances butter fat content drops equally suddenly.

There is a seasonal variation of fat content, the maximum being reached during early winter, and the minimum during the summer grazing period when the grass is "flush." Many factors contribute to these differences, the major ones probably being changes in food and in temperature. Seasonal variations also occur in the activity of the pituitary, which may possibly contribute to these changes.

In an individual cow there is not much variation in the average content in milk from one lactation to another. The increases in the first few lactations are not accompanied by any corresponding reductions in average fat contents. Generally, there is a slight rise in fat until the cow is mature, at about five years old, and a decline from six or seven years onwards. Consequently, the fat content of a heifer's normal lactation can be regarded as a fairly accurate index of the likely fat yield of the same animal when mature, and can serve as a basis for selection should this be desired. A heifer which gives a very low fat content in her first lactation is not likely to become a satisfactory milker so far as fat content is concerned in subsequent lactations.

Influence of Food Supply.—This is a difficult subject to discuss briefly. There is still some disagreement between authorities. Probably no single aspect of milk secretion has stimulated more investigational work than the question of the influence of food on quality and quantity of milk.

As outlined above, milk secretion is inherently dependent upon the nature and state of development of the udder, as well as upon the kind and amount of the food intake. The food does influence actual volume of secretion markedly, but the effect upon the composition of the milk is more limited. It is exceedingly difficult to influence the amount of fat secreted over an extended period of time by varying the nature of the food within the limits which are practicable and desirable on an ordinary dairy farm where balanced rations are used. The exceptions perhaps are related to palm kernel and coconut cakes. These two cakes, more commonly used on the Continent than in Britain, do appear to cause a certain amount of increase in the levels of fat secretion, especially when they are used in a herd where fat secretion is already below normal. There is evidence that the cause of this increase is associated with the residual oil present in the cakes. Both coconut oil (or coconut "butter") and palm kernel oil approximate somewhat closely to the chemical characters of milk fat. It is known that by feeding ordinary butter to a cow for a period, it is fairly easy to raise the fat content in her milk at least temporarily. The present indications are that the more closely the fatty acids in the food resemble those in the milk, the more readily will they be utilised by the mammary cells for the production of milk fat.

So far as adverse effects upon fat secretion are concerned, there are some striking instances. Cod liver oil, fed in amounts of four to six ounces daily, and in some cases as little as two ounces, will markedly lower the fat content, while some vegetable oils, especially rice oil, usually have the same effect. More pronounced effects of food are seen on quality of fat than on amount. The effects of oils in the food upon softness or hardness of the butter are fairly well known. When the food contains a large amount of unsaturated fatty acids, these pass readily into the milk and cause a soft and greasy character to be imparted to the butter. The higher the proportion of unsaturated fatty acids in the food as compared with the proportion in milk fat, the greater will be the softening tendency. Milk fat is formed not only from the fats in the food, but partly from the carbohydrates. The greater the total fat percentage in the ration, and the greater the digestibility of this fat, the greater it will contribute to the milk fat, and therefore the more will food fat influence milk fat. These facts can be made use of on a butter-making farm: when softer butter is wanted as in winter, maize meal, rice meal and linseed cake may be included in the ration until the desired effect is achieved; while in summer, the use of extracted cottonseed meal, palm kernel cake or coconut cake will harden the fat and produce a firmer butter.

Influence of Energy and Protein Supply.—Amongst organic substances protein has the most marked effect upon milk secretion. The magnitude of the effect depends upon whether the total food supply is adequate or not. If the total food intake is inadequate but includes adequate protein, the result is a gradual fall of milk yield to a level at which an equilibrium between intake and outgo is established. In other words, the cow secretes as much milk as she is getting food to utilise. The composition of the milk remains, however, constant. If the total food intake is inadequate and supply of protein is deficient, the yield falls more rapidly, and the fat content falls below normal levels. If, however, the fat content was subnormal before (say less than 3·0 per cent.) little further fall in fat content is noted. If the total amount of food intake is normal, but the protein supply is reduced, the result will vary according to whether the fat content was previously high or low. Where the fat content was high, the first effect of reducing the protein is to cause a lowering of fat content. Volume remains steady. Later, when a negative nitrogen balance is well established, the volume decreases. If the fat content

was low before altering the food, the effect on the butter fat is not noticeable: the lowering of yield is the only marked change to occur.

When the periods of deficient protein intake have been short, restoration of a properly balanced diet (*i.e.*, with adequate protein), is followed by normal levels of milk secretion; but if a longer period has elapsed the amount and quality of the milk may not be capable of being restored to normal.

It should be noted that various disturbances of the digestive organs result in a lowered capacity to digest protein and to assimilate a sufficient amount of energy from the food. Although the sick animal may eat a reasonable ration it may suffer from tissue starvation exactly similar to the cow on an artificially constituted inadequate diet. The result is the same—milk secretion suffers in quality first, then in quantity. The same train of events follow most fevered conditions and loss of appetite from any cause.

From what has been said, it will be readily realised how important it is to keep cows at the pitch of perfection so far as quality and quantity of food are concerned, particularly with high-yielding animals. The greatest care must be taken in the compounding of rations to ensure that the intake is adequate and the rations are balanced, especially so far as protein is concerned. The actual amount of protein equivalent required per gallon of milk produced varies between 0·4 and 0·68 or 0·7 lb., according to the amount of fat in the milk. The standard amounts laid down in the official publications of the Ministry of Agriculture can be followed with confidence. For maintenance purposes, 0·6 lb. of protein equivalent per 1,000 live weight of cow is the accepted standard.

In theory it should be necessary to provide a supply of proteins containing adequate amounts of essential amino-acids, *i.e.*, proteins of high biological value. Lysine is probably the most important amino-acid needed for milk production, and lysine-rich foods, such as bean meal, fresh green grass, and blood fibrinogen meal, and to a less extent soya bean cake, earth-nut cake, etc., should be included in rations for heavy milkers. It should, also, not be forgotten that variety in the proteins of the food is very important. It has been shown that when only one protein is fed it is utilised less efficiently by the body than when two or more proteins are combined. Probably, in practice, if an adequately mixed protein supply is present in the ration, most cows will be capable of satisfying their full demands for protein, without the need to determine the number of grammes of each amino-acid that are being taken in daily.

Influence of Minerals.—The mineral contents of blood and milk are not identical; milk serum contains more calcium and potassium, but less phosphorus, sodium and chlorine than blood plasma. At the same time, the osmotic pressure of each is equal. These facts prove that the mineral constituents in milk are not derived from the blood stream by simple physical osmosis, but are selected by a living process of secretion.

In an individual cow there is normally very little change in the proportions of the mineral constituents of milk throughout a lactation. [*Note.*—In the mare there is a marked fall as lactation progresses, both in the total solids, in total ash, and in each of the principal salts.] The amount of minerals in the food has only a slight effect upon the proportions found in the milk in the case of calcium, phosphorus, and iron, but iodine fed by the mouth is partly excreted from the system by the udder, and therefore the iodine level in milk can be raised artificially within certain limits.

Experimental work has shown that the chief mineral deficiencies likely to arise on farms in Britain are those of calcium, phosphorus and sodium, with rarely chlorine. Calcium and phosphorus together form about half the total milk ash, and about one-fifth of an ounce of them is contained per gallon of milk. The food should contain at least twice the amount of this loss, since there is a certain amount required for maintenance for possible pregnancy, and there is always a low rate of absorption from the food. Experiments have shown that no matter how much calcium and phosphorus are fed to heavy-milking cows during the early part of lactation, there is almost always a negative calcium and phosphorus balance: that is the cow's system loses more in milk, faeces and urine than she takes in by the mouth. The extra amount lost is removed from the bones. Towards the end of lactation and during the dry (or "recuperative") period an opportunity occurs to store both calcium and phosphorus, and a period of positive balance replaces the negative phase. Consequently, during the second half of lactation and during the dry period it is important that adequate supplies of minerals should continue to be used.

Since part of a cow's concentrated rations usually comprises a proportion of cereal or other seeds or residues which are rich in phosphorus (*e.g.*, bran, maize, oats, etc.), and since phosphorus is readily built up in the system, there is little likelihood that a shortage of phosphorus will occur under actual normal farming conditions in this country. With calcium, which is not assimilated and stored so readily, and which is more likely to be deficient, a lack may, and probably does, occur. There is some evidence that an excess of phosphorus may lead to a reduction in milk yield, but on the other hand, phosphorus plays an important part in milk fat synthesis in the udder, so that it must not be neglected. (In certain phosphorus-deficient areas, *e.g.*, in parts of Africa, where herbage contains a very small amount, reproduction and lactation may become almost impossible.)

Continuous lack of adequate calcium or phosphorus results firstly in a depletion of the skeletal reserves, and later, when these reserves are gravely depleted, milk yield suffers. The effects are shown by a reduction of the normal length of the lactation period, or perhaps by a lowering of the peak yields in succeeding lactations. The effect of small deficiencies of calcium and phosphorus is produced only very slowly and may not become obvious for some years. The cumulative effect is to shorten the productive life of stock. These effects are intensified when there is a simultaneous shortage in the intake of vitamin D.

Wifth reference to the actual amounts of calcium and phosphorus it is difficult to find records of any precise information. Forbes *et al.*, of Ohio, who have done much original work, suggest that for a 1,000- to 1,100-gallon cow the proportion of calcium and phosphorus should not fall below 0·3 per cent. of the dry matter intake. Michigan Agricultural Station experiments led to the conclusion that (*a*) for every 1,000 lb. of live weight the cow requires for maintenance: calcium, 8·0 grm.; phosphorus, 10·0 grm.; (*b*) for every pound of milk secreted: calcium, 0·9 grm. and phosphorus 0·75 grm. If

this is applied to a cow of 1,200 lb. live weight producing five gallons of milk daily at the peak of lactation, she will require calcium, 55 grm. (2 oz.) and phosphorus, 50 grm. (1·8 oz.) In a ration containing 35 lb. dry matter, the above amounts would constitute approximately 0·35 per cent., which agrees with Forbes's suggestions. During the dry period the Michigan work indicates that about 17 to 20 grm. (about ¾ oz.) of both calcium and phosphorus should be supplied daily.

Danish workers recommend that where heavy root rations are fed, some 50 to 60 grm. (about 2 oz.) of chalk should be fed daily, or 60 to 70 grm. if the roots are reduced. This addition is intended to ensure a better balance between the intakes of calcium and phosphorus in the ration. To improve the sodium-potassium ratio an addition of some 30 to 50 grm. of sodium chloride is recommended and this is confirmed by American workers.

Vitamin Supply.—Accurate knowledge of the exact vitamin requirements of dairy cattle for milk secretion is not available. Cows require supplies of vitamin A for normal body functions, but whether extra supplies are required during lactation has not yet been shown clearly. When a vitamin-deficient diet is fed to milking cows, the first demonstrable effect is that the vitamin content of the milk falls. Conversely, if the intake is increased, the vitamin content in the milk rises. If a pregnant cow is fed adequately with vitamin A, the calf born does not possess a great reserve of vitamin A in its liver; it must receive and build up a supply via the dam's milk after birth, and the reserve stored in the maternal liver is released to enrich the milk for this purpose. The same applies to vitamin D.

There is some evidence that a deficiency of vitamin B_1 lowers the amount of milk secreted by the rat, but no corresponding effects have been noted in farm animals. Cow's milk contains only small amounts of B_1, and it is difficult to influence this amount either positively or negatively by modifications in feeding. It appears that the same applies to B_2, except that cow's milk normally contains larger amounts. Vitamin C is probably not essential for lactation, but so far as vitamin E is concerned, again some preliminary evidence from work with rats indicates that it may be required for normal milk secretion. The influence of the intake of vitamin D upon calcium and phosphorus has been briefly referred to earlier in connection with minerals.

VETERINARY EXPENSES ON DAIRY FARMS

Costs of veterinary services and medicines on 133 farms producing non-accredited milk, on 304 producing accredited milk, and on 64 producing T.T. milk in England and Wales in 1936-37, according to Mr. F. R. G. N. Sherrard, who writes in the December, 1938, edition of *The Farm Economist* (Agricultural Economics Research Institute, Oxford, post free, 1s.), vary from under 5s. per cow to over 15s. per cow.

Of the farms where costs are less than 5s. per cow, 73·7 per cent. are in the non-accredited group, 58·2 in the accredited, and 17·2 in the T.T. groups. As much as 46·9 per cent. of the T.T. cows cost over 15s. per annum in veterinary expenses, but only 3·7 and 8·9 per cent. of the non-accredited and accredited. The average costs are 4s. 8d. per cow in non-accredited herds, 5s. 8d. in accredited, and 14s. 4d. in the tuberculin-tested group.

Notes and News

The Editor will be glad to receive items of professional interest for inclusion in these columns.

Diary of Events

Jan. 16th.—Meeting of the Editorial Committee, N.V.M.A., at 36, Gordon Square, W.C.1, 4 p.m.

Jan. 20th.—Annual Meeting of the Mid-West Division, N.V.M.A., at Bristol, 2.30 p.m.

Jan. 20th.—Meeting of the Sussex Division, N.V.M.A., at Brighton, 2.45 p.m.

Jan. 20th.—Meeting of the Council of the South Wales Division, N.V.M.A., at Swansea, 3 p.m.

Jan. 21st.—Meeting of the Society of Veterinary Practitioners, at York, 2.15 p.m.

Jan. 27th.—Meeting of the Society of Veterinary Practitioners, at Bristol, 2.30 p.m.

Jan. 27th.—Annual General Meeting of the Royal Counties Division, N.V.M.A., at the Caversham Bridge Hotel, Reading, 5.30 p.m.

Jan. 28th.—Meeting of the Scottish Branch, N.V.M.A., at the North British Station Hotel, Glasgow, 2.30 p.m.

Feb. 1st.—Annual General Meeting of the Lancashire Division, N.V.M.A., at Liverpool, 2.30 p.m.

March 2nd.—Voting Papers for R.C.V.S. Council Election issued to members overseas.

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PERSONAL

Bequest to the London College.—Among the bequests made by Mrs. Emilie Agnes Elin, of Meldreth, Cambs., who died on October 10th, 1938, is the sum of £500 to the Royal Veterinary College.

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Colonial Veterinary Service Promotions.—The following promotions in the Colonial Veterinary Service are announced:—

Beaton, W. G., M.R.C.V.S., D.T.V.M. (Senior Veterinary Officer), Deputy Director of Veterinary Services, Nigeria.

Lowe, H. J., M.R.C.V.S. (Senior Veterinary Officer), Director of Veterinary Services, Tanganyika Territory.

Mackintosh, Captain W. L. S., M.R.C.V.S., D.V.M., D.T.V.M. (Veterinary Officer), Senior Veterinary Officer, Uganda.

Simmons, R. J., M.R.C.V.S. (Senior Veterinary Officer), Director of Veterinary Services, Uganda.

. . . . .

Illness of Dr. Tom Hare.—His very wide circle of friends in the profession will share our deep regret that the indisposition from which Dr. Tom Hare has been suffering for some little time, developed acutely on Thursday of last week, necessitating the performance of an operation for appendicitis on the evening of that day, in a nursing home in St. Albans. We are very glad to learn that entire success attended the operation and that Dr. Hare is progressing satisfactorily.

R.C.V.S. OBITUARY

Brooke, William Henry, Avalon, Northleigh Avenue, Milton, Weston-Super-Mare (formerly of Handsworth, Birmingham). Graduated London, April 12th, 1888. Died January 10th, 1939.

The Late Mr. W. H. Brooke, M.R.C.V.S.

An Appreciation

In reference to the death of Mr. W. H. Brooke, which we record above with much regret, a colleague writes:—

"The death of Mr. W. H. Brooke, of Weston-super-Mare, which took place on Tuesday last, came with a shock to his many friends in the Midlands and throughout the profession. Qualifying some 50 years ago at the Royal Veterinary College, London, he practised in the Birmingham district for upwards of 40 years, and when he retired a few years ago and went to live at Weston-super-Mare, he left a wide circle of friends in that city and the surrounding districts. A prominent member of the Midland Division, he acted as Treasurer of the Association for many years and was a constant attender at all its meetings. For many years he specialised in the small animals and at a time when canine practice was in its infancy, Brooke had a wide reputation as a highly skilled veterinarian. He had many and varied interests outside his practice. For a number of years he lectured in Biology to the Birmingham Technical School and was keenly interested in the activities of the Midland Institute and the Midland Archaeological Society. In the subject of Archaeology he was widely read and had an extensive knowledge of the subject as applied to the Midlands. A charming companion to both young and old, "Willie" Brooke, as he was affectionately known to his friends, had an outstanding capacity for lasting friendships and many are the friends who will be the poorer for his loss. He carried his hobbies into his retirement, which he enjoyed to the full, and on those occasions when he came among his professional colleagues, his delight at renewing old friendships and his keen interest in practical matters were enjoyed to the full by those who were fortunate to be numbered among his friends. The writer well remembers his pleasure when, at a meeting of the Midland Counties Veterinary Association last year, he was made a presentation by the members in view of his long services as Honorary Treasurer. The veterinary profession and his friends will be the poorer for his passing. H. W. D.

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Mr. Brooke, who was 70 years of age, leaves a widow and a married daughter, to whom the deep sympathy of the profession will be extended.

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Morton, Wemys Sherlock Essex, 18a, The Pantiles, Tunbridge Wells, Kent, Captain late R.A.V.C. Graduated Edinburgh, May 19th, 1904. Died January 9th, 1939; aged 69 years.

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UNIVERSITY OF LONDON B.Sc. (Vet. Sci.)

Following is the Pass List of the final examination for the degree of Bachelor of Science (Veterinary Science) in the University of London:—

Barnett, Stephen Frank, Royal Veterinary College.

Lee, John Arthur, Royal Veterinary College.

Worden, Alastair Norman, Royal Veterinary College.

The following student has passed in Part II of the examination:—

Crowther, Robert Wade, Royal Veterinary College.

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ARMY VETERINARY SERVICE

Major T. Hodgins retired on November 1st, 1938, and has obtained an appointment in Trinidad.

Movements of Officers

Captain J. L. Dalzell returned from India on October 31st, 1938, and has been posted to the Royal Military College for duty.

Major M. A. Murphy returned from Hong Kong on December 10th, 1938, and has been posted to Colchester for duty.

Captain J. Clabby arrived home from India, tour expired, and joined at Catterick for duty on December 30th, 1938.

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LECTURES ON ANIMAL BREEDING

Under the auspices of the Univeristy of London, in the current series of special university lectures in agriculture, a course of four lectures on animal breeding will be given in the Metallurgical Lecture Theatre of the Imperial College of Science and Technology—Royal School of Mines—Prince Consort Road, South Kensington, S.W.7, by Dr. John Hammond, F.R.S., of the Animal Nutrition Institute, School of Agriculture, University of Cambridge, at 5.30 p.m. on Thursdays, January 19th and 26th, and February 2nd and 9th, 1939. The lectures will deal with genetics in relation to the practical problems of breeding farm animals. Lecture I.—Introduction, Mendelian applications; II.—Evolution and Selection; III.—In-breeding and cross-breeding; IV.—Special problems in breeding for production. General conclusions.

The lectures, which will be illustrated with lantern slides, are addressed to students of the University and to others interested in the subject. A bibliography will be available at the lectures. Admission free, without ticket.

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HEALTH AND AGRICULTURE

The efficiency of British agriculture is now universally recognised amongst us as a matter of far more than merely business concern, and to describe this basic pursuit of our people, as does the *British Medical Journal*, as occupying "a foremost place among public health services," to-day will be deemed by no one to be an overstatement. This prominence, says the journal, is accorded to efficient agriculture by the pre-eminent influence of food in determining man's general physical endowment, powers of endurance, and resistance to disease. "It was inevitable that those whose business lay in the investigation of the relations of food to health and disease and of the health-promoting properties of certain natural foodstuffs should have come to regard the proper care and cultivation of the soil and the economic production of health-giving foodstuffs as a most important public health measure. But the attempt to induce the public, the Government, and the farmer himself so to regard agriculture—and in consequence of this regard to establish it as part of a comprehensive public health policy—has been the business of others. Last year the League of Nations published the final report of the Mixed Committee, presided over by Viscount Astor, on 'The relation of nutrition to health, agriculture, and economic policy': a

report replete with information on this highly important matter. In it there occurs a passage which cannot be too often repeated:—

'Millions of people in all parts of the globe are either suffering from inadequate physical development or from disease due to malnutrition or are living in a state of sub-normal health which could be improved if they consumed more or different food. That this situation can exist in a world in which agricultural resources are so abundant and the arts of agriculture have been so improved that supply frequently tends to outstrip effective demand remains an outstanding challenge to constructive statesmanship and international co-operation.'

"Now there appears another report of an inquiry on British agriculture[1] organised by Lord Astor and Mr. Seebohm Rowntree which is of profound interest from the point of view of national health in this country. They set themselves the task of answering these questions: What can British agriculture produce most effectively and most economically, having regard to our soil, climate, and economic conditions? What does the consumer need most from British agriculture? They came to the conclusion that the best interests of the agricultural producer and of the consuming public coincide. The new knowledge of nutrition emphasises the importance to human welfare of the consumption of adequate quantities of the 'health-protective' foods as distinct from the energy-bearing foods. The main foods falling into this category are milk (pre-eminently), fresh fruit, vegetables, and eggs. And for the production of these Britain is especially fitted by natural conditions; and can be still better fitted, in regard to milk, by the application of the new knowledge now available for improving grassland cultivation. Moreover, British farming enjoys a natural protection in these perishable products through proximity to the market. 'We should therefore aim at affecting a marriage of agriculture and nutrition by subsidising the production of the protective foods rather than in giving subsidies to the production of energy-bearing foods. This policy would not only further the interests of agriculture in Britain but would also have an inestimable value on the standards of national health.'

"In practice, as the authors of the report point out, the central feature of a constructive nutritional policy must be the promotion of the consumption of milk. The potentialities of enlarging agricultural production by a successful policy of stimulating milk consumption are very large. The present average *per capita* consumption of milk by the British public is extremely low. If it were increased by one-third of a pint a day it would still be far below the level which is desirable on nutritional grounds; yet such an increase would entail an expansion of our natural milk output of no less than 65 per cent. At the present rate of productivity this would require the maintenance of two-and-a-half million more cows. The authors of the report urge that the constitution of the marketing boards which administer the various statutory marketing schemes should be transformed. They recommend that these boards should be appointed by the appropriate departments of State to represent the public interest: a reform which, in their judgment, is essential if agricultural marketing is to evolve on satisfactory lines. 'It would be far easier to develop constructive schemes for stimulating an increased consumption of milk and other protective foods, or for improving the system of retail distribution, if the powers of the marketing boards were in the hands of bodies representative of the public interest.' With the other proposals here put forward we are not immediately concerned. State ownership of certain lands, land improvement commissions, measures for increasing farming efficiency, educational and advisory services, more energetic attempts to eradicate animal disease, improving the quality of the product in many branches of farming, measures to maintain and improve the fertility of the soil, improvements in conditions of life of agricultural workers—all these are among them. What concerns the medical profession as guardian of the public health is that agriculture should be given its rightful place among the public health services, and that the agricultural policy of the future should be part and parcel of a national policy of nutrition. The report by Lord Astor and Mr. Seebohm Rowntree will, by developing public opinion, contribute greatly to the attainment of this much-to-be-desired end."

(1) *British Agriculture: The Principles of Future Policy.* A report of an inquiry organized by Viscount Astor and B. Seebohm Rowntree. (Longmans, Green and Co. 15s.)

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The annual report of the Cleveland Bay Horse Society states that 1938 has been a year of unceasing activity. The War Department granted a premium which was awarded to Mr. W. Welford's Morning Star. A grant of £25 was given by the Racecourse Betting Control Board and this sum was utilised to subsidise Mr. J. W. Lett's stallion, Hard Times.

Correspondence

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

All correspondence must bear the name and address of the contributor for publication.

The views expressed in letters addressed to the Editor represent the personal view of the writer only and must not be taken as expressing the opinion or having received the approval of the N.V.M.A.

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THE LOVEDAY REPORT

To the Editor of the Veterinary Record

Sir,—Professor Whitehouse has given such long, unselfish and devoted service to our profession that one hesitates to question his considered opinion on the Loveday Report or on the needs of veterinary education.

I write with all reverence and respect for the Glasgow College, its staff and principal, and with deep appreciation of its work, but I cannot see that any member of our profession could be satisfied with the existing facilities at that college.

In all the colleges the responsibility for the clinical instruction of the future veterinary surgeon appears to be left to the student and the general practitioner if they can get together. A student may derive valuable instruction and profitable experience during pupilage, but more often he does not and as a substitute for scientific clinical instruction the arrangement is farcical and grossly unfair to many students.

The practical and clinical application of our academic training is of paramount importance if we are to raise our prestige and hold the trust our country may give us.

Let us keep our inferiority complex but give the coming generation every help in our power to realise their ideals and give good service.

I cannot see how the recommendations of the Loveday Report with the co-operation of our

members could fail to benefit enormously the future veterinary services of the country.

Yours faithfully,
B. G. Catmur.

The Vineyard,
Abingdon,
Berks.
January 4th, 1939.

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POTENCY OF TUBERCULIN

To the Editor of the Veterinary Record

Sir,—I have been both surprised and disappointed to note that so far the recent article on "The Potency of Synthetic Medium Tuberculin," by Dr. R. F. Montgomerie and Mr. A. Thomson, has passed entirely without comment. To my mind, this is a matter of paramount importance to the profession as a whole.

Firstly, it must have an important bearing on the success of the various tuberculin testing schemes, and secondly, it materially affects the reputation of the profession as regards its ability and integrity.

Until recently, I had always imagined that a highly potent tuberculin would be the natural choice of all who had tuberculin testing to carry out, as being more satisfactory to the veterinary surgeon and more economical to the stock owner. In this light I concluded that the official tuberculin was a highly potent one, but, having had the opportunity of making an extensive trial by simultaneous testing, of Langley Court and Camden Town tuberculins, I can only say that my conclusions are entirely in agreement with those stated in the article.

Surely when tuberculin testing is so important, some agreement should be reached as to which potency is the better one to use. In this connection it is interesting to note that, in the results recorded, and in a practical demonstration which I saw at Taunton, the U.S.A. tuberculin was if anything slightly more potent than the Langley Court material, thus demonstrating the American view on the question.

To the many to whom this recent article must have come as rather a shock, and in whom, feelings of doubt must arise, I would say that I know the authors are keen that a thorough trial be made of this tuberculin by competent outside observers.

In conclusion, I should like practising veterinary surgeons to consider their position when testing animals for sale purposes with an accepted tuberculin which may fail to reveal an appreciable proportion of animals affected with tuberculosis.

Yours faithfully,
J. B. White.

49, Endless Street,
Salisbury.
January 9th, 1939.

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WHITE HEIFER DISEASE

To the Editor of the Veterinary Record

Sir,—From time to time there have been reported in the pages of the *Veterinary Record* cases of white heifer disease. It is described in some text-books as being brought about by an imperforate hymen. This is not my experience, which is based on over 100 cases extending over many years. My object in writing this is to seek the opinion of other veterinarians. True white heifer disease, in my view, is caused by an abnormally short vagina ending at the seat of the hymen, which is just in front of the *meatus urinarius* with a definite occlusion of the *os uteri*, which is malformed. It will, therefore, be seen that there is no definite hymen as such, nor is there a properly formed vagina, because the uterus proper is pulled back into the pelvis and the *os* is much nearer the external vulvar opening than in a normal case. The distended uterus can be felt distinctly by a rectal examination. The disease nearly always affects white heifers about two years old, hence the name, but greys and roans are also affected and I have seen it in an all-red heifer and even in an Aberdeen Angus heifer. Oestrum may or may not be present. The first symptom usually follows after mating with the bull, but it may appear after a railway or road journey if a sufficient quantity of material exists in the uterus to bring about the necessary discomfort.

The nature of the uterine contents varies very considerably both in quantity, appearance and consistency. It may be more or less watery, or it may be whitish in colour with or without an offensive smell, or it may resemble amniotic fluid. The treatment consists in puncturing the obstruction with a pair of expanding forceps and dilating it sufficiently to allow the contents to escape. The operation is not always simple, and I have even had to puncture the wall of the uterus in front of the *os*, but cases of this sort are generally the result of several false services. I do not advise flushing out the womb nor have I done so for many years. I find iodoform pessaries are the best antiseptic for after-treatment. It is advisable to fatten such a heifer as soon as possible as the operation is only a temporary success and in some cases I have operated twice and even three times on the same heifer.

Persistent hymen is an entirely different condition. The hymen is situated in the proper place and there is no danger in rupturing it because the opening is into a properly formed vagina. I have met six such cases and nearly all in white heifers. The obstruction was discovered at the first calving and proved a very formidable obstacle to parturition. It took considerable force to break down the hymen and naturally the act of parturition was attended with considerable bruising of the vaginal walls at that point and consequent haemorrhage. The burst fibres in the hymen at the time of service must have re-united after copulation, otherwise conception could not have taken place. Fleshy bands are often found across the vagina of cows. The position of the bands I have met in such cases could not be connected with the original remnants of a torn hymen.

Yours faithfully,
F. W. Hart.

Enniskillen.
January 7th, 1939.

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CATTLE DISEASES AND MILK

To the Editor of the Veterinary Record

Sir,—My old friend, Mr. Mayall, remarks that the *real functioning* of the Animal Health Department seems very slow in eventuating. It has not yet been in existence for a year, but I think that when it issues its first annual report, it will amply show that its institution was justified, and that we as a profession will be proud of the headway it has made. I think that we should regard it as very fortunate, remembering that

agriculture is the most neglected of all our industries—although by far the most important, as coming events will show—that there was found a Minister progressive enough to realise and, moreover, secure the unanimous support of *all* parties in launching a scheme from which we as a profession will profit both materially and morally.

Until it is made compulsory for all cattle not destined for slaughter to be tuberculin tested, and to prohibit the sale of milk save from such cattle, we cannot make great headway in the eradication of tuberculosis. The accredited herd licence system I regard as an utter farce, and not worth the paper it is written on. Such cattle are not only untested, but in not a few instances are composed of reactors and throw-outs from a tested herd.

Our hands are tied in using the one agent which controls the losses from contagious abortion, thanks to the dictation of a profession whose attitude towards us has not changed a scrap, either socially or professionally, since the disastrous days of the Coleman regime at the London College; but no comment is made on the greater danger from cattle naturally infected, or on the reputed far more virulent source—that of the pig. Let those who want university representation on our Council note the kind of nonsense to look for, should their hopes ever materialise.

The farmer views all new institutions with suspicion, and asks, "How can we eradicate the diseases we are out to stamp out if those affected are offered for sale by public auction?" Some time ago, I recommended to the local branch of the N.F.U. that reactors to the tuberculin or agglutination test, should be branded, so that the buyer knew what he was buying. This was passed by them, but rejected by the headquarters of the N.F.U., who appear to be bound hand and foot to the present Government and will not *demand* what they want. It was regarded as a hardship to penalise the seller, but not so the buyer. On poor unhealthy soil, the farmer is expected to produce bumper crops, and rear healthy cattle. Starting as usual at the wrong end, the Government provides cheap fertilisers, whereas if his produce showed a profit, the farmer would, as a matter of annual routine, buy only the best.

The qualifications which the modern veterinary surgeon should possess, as advised by Mr. Ware, would, at any rate, have been present in the graduates of one of our colleges if, when it was going to be rebuilt, the Governors—and mark those who shout co-operation—not members of, or representative of, the profession, had not sacrificed it on the high altar of small animal practice and easy accessibility to themselves—and when the funds had been raised, dispensed with the services of the one member of our profession who had made its rebuilding possible.

Yours faithfully,
J. F. D. Tutt,

"Rothiemurchus,"
St. Cross,
Winchester.

The governors of the College of Estate Management offer a travelling scholarship in agriculture to the value of £300 per annum. Applicants, who must not be over 30 years of age, should be graduates of a British university, or should possess such other qualifications as may be accepted by the governors. Application forms may be obtained from the secretary of the college, 35, Lincoln's Inn Fields, W.C.2, and are returnable not later than February 1st.

DISEASES OF ANIMALS ACTS, 1894 TO 1937, AND AGRICULTURE ACT OF 1937 (PART IV)

SUMMARY OF RETURNS

Period.	Anthrax.		Foot-and-Mouth Disease.		Parasitic§ Mange.		Sheep Scab.	Swine Fever.	
	Outbreaks confirmed.	Animals attacked.	Outbreaks confirmed.	Animals slaughtered as diseased or exposed to infection.	Outbreaks reported by the Local Authorities.	Animals attacked.	Outbreaks confirmed.	Outbreaks confirmed.	Swine slaughtered.
	No.	No.	No.	No.	No.	No.	No.	No.	No.
Period 16th to 31st Dec., 1938	37	40	11	919	—	—	14	54	21
Corresponding period in									
1937	51	54	58	7,953	5	6	8	26	21
1936	37	41	8	486	8	9	33	61	25
1935	24	26	6	657	3	4	37	84	39
Total 1st January to 31st Dec., 1938	831	1,234	190	23,777	46	76	222	951	735
Corresponding period in									
1937	743	879	187	31,586	115	179	253	982	584
1936	468	551	67	5,316	111	254	255	1,873	1,270
1935	386	443	56	12,444	99	222	477	2,049	1,238

NOTE.—The figures for the current year are approximate only. § Excluding outbreaks in Army Horses.

Tuberculosis (Attested Herds) Schemes

The number of Attested Herds, *i.e.* herds officially certified as free from tuberculosis as at 31st December, 1938, was as follows:— England 1,189 ... Wales 2,340 ... Scotland 1,115 ... Total (Great Britain) 4,644